THURSDAY, JULY 28, 1892.

GROUSE DISEASE AND FOWL ENTERITIS.

The Etiology and Pathology of Grouse Disease and Fowl Enteritis. By E. Klein, M.D., F.R.S. (London: Macmillan and Co. 1892.)

IN this book Dr. Klein has given the results of an important series of researches made by him upon certain diseases in birds. The malady which has specially occupied his attention is that commonly known as the grouse disease. The book will therefore find a large and appreciative circle of non-professional readers. To all interested in the preservation of game it may be commended as furnishing for the first time an adequate and satisfactory explanation of the origin and mode of propagation of the grouse disease. The book is over and above that a valuable contribution to bacteriology. The very excellent illustrations appended enable one to follow the text with great ease. The birds affected are the red grouse (*Lagopus scoticus*) of our moors. The disease, when it breaks out in the spring or summer, is usually of a very virulent type. A fatal epidemic then arises which carries off large numbers of the birds, to the despair of the owners and keepers, who find themselves powerless to cope with the malady. It is to this quickly fatal epidemic that the name of the grouse disease is applied. Though much written about and much discussed, the origin of this disease has hitherto remained undiscovered.

During the last five years numbers of birds, dead or dying from the disease, were sent to Dr. Klein from moors in England and Scotland. The large amount of material furnished has enabled him to make an exhaustive inquiry.

The result is the most noteworthy account yet published of the etiology and pathology of the disease. Dr. Klein has proved that it is an acute infectious malady primarily affecting the lungs and liver of the birds. The symptoms and appearances are those of an acute infectious pneumonia. Dr. Klein has further discovered the *causa causans* of the disease in the shape of a minute unicellular organism, belonging to the class of the bacteria. This microbe has its special seat in the lungs and liver. It is a bacillus, and is found filling and blocking up the capillary blood vessels in the diseased areas of the lungs and liver. The organism can be isolated from the diseased tissues and grown on suitable media outside the body. In this way a series of culture of the bacilli were made on various soils—gelatine, Agar, beef broth, &c. The manner of growth of the microbe in these culture media is very fully described. The growths obtained were always of the same bacterial species. The pure culture of the bacillus subcutaneously inoculated into healthy animals reproduced the symptoms and appearances of the disease. They proved fatal to mice and guinea pigs, and caused in them a congestion of the lungs and liver. No effect was produced on pigeons and fowls. The most virulent cultures of the microbe were those grown in meat broth to which a piece of coagulated white of egg had been added. The most positive results were obtained with the common bunting and yellow-ammer. These birds were inoculated with a minute drop of a meat-broth culture of the microbe. They succumbed within twenty-four hours. The post-mortem appearances were similar to those found in the grouse, viz., a marked congestion of the lungs and liver. The bacilli were found in large numbers in the lungs. From these experiments Dr. Klein was able to conclude that the grouse disease is due to the microbe isolated by him from the diseased organs of the birds. Unfortunately he has not been able to reproduce the disease in large birds, or to utilize healthy grouse for his experiments. In the latter case the difficulty in obtaining living birds and keeping them in captivity prevented this last and most important proof being furnished. The larger birds experimented with (fowls and pigeons) proved unsusceptible.

The infection of the birds seems to take place through the respiratory organs. Dr. Klein furnishes a very striking experiment in support of this view. A yellow-ammer, after being inoculated with the grouse bacillus, was placed in a cage adjoining to one containing six healthy ammers. These six healthy birds acquired the disease and died.

The autumnal disease of the grouse is similar to the spring and summer disease, and both are caused by the same microbe.

The bacilli found in the autumnal disease are, however less virulent than those found in cases during the spring and summer. The buntings and ammers inoculated with the autumn microbe died at a much later period. Mice that had survived inoculation with the autumn microbe did not succumb when inoculated with the more virulent spring microbe. Dr. Klein suggests that cultures of the autumnal microbe might be used as a protective vaccine for the young birds on the moors. It is to be feared that those on whose shoulders this task would fall might prefer the disease to the cure.

The bacillus is easily killed. A temperature of 60° C. completely destroys its life in five minutes. On the other hand, virulent meat broth cultures heated for twenty minutes to 55° C., retained their virulence and yielded normal growths when grown in a fresh soil. This more prolonged heating so near the critical temperature for the bacilli (60° C.) did not, as one would have supposed, produce any retardation in their subsequent growth or any attenuation of the organisms.

Meat broth cultures, in which the bacilli had been destroyed by heat, produced in mice all the symptoms of the disease. This points to the presence in the meat broth of some poisonous chemical product. The matter is referred to very briefly, but we hope Dr. Klein will soon be in a position to tell us more about this interesting and important discovery.

To prevent the spread of the grouse disease the importance of weeding out suspicious birds from the moors is emphasized. The birds killed should be removed and burned.

Dr. Klein describes in the next place a bacillus which he isolated from garden earth. Guineapigs, rabbits, and mice, when inoculated with this organism, developed an œdema of the subcutaneous and muscular tissues. The organism is aerobic, and grows well in the presence of free oxygen, and on the surface of culture media. It is therefore not identical with Koch's bacillus of malignant

œdema, which is an anaerobic organism. Though it resembles the bacillus of grouse disease in certain respects, they are not to be regarded as one and the same microbe.

The second part of the book contains an account of a fatal epidemic amongst fowls which broke out at Orpington in Kent. The symptoms and post-mortem appearances led Dr. Klein to designate the disease fowl enteritis, in order to distinguish it from fowl cholera. The bacillus which is the cause of fowl enteritis is not identical with the bacillus of fowl cholera, and Dr. Klein clearly proves this.

Dr. Klein's bacillus is evidently a less virulent organism. In only one case was the disease produced by feeding fowls with the intestinal contents of a diseased fowl. Experiments on other animals gave practically negative results, except in the case of one rabbit. The virulence of the bacilli was lessened by heat. Fowls inoculated with this attenuated virus could not be infected with the disease. Some practical suggestions are given with a view to combating such epidemics.

The concluding chapter of the book contains an interesting account of a disease in young pheasants known as "Cramps."

We have given but a very brief account of Dr. Klein's important investigations. The book will, however, be read by every one interested in the subjects of which it treats, and with great profit. To other workers in the same field it will prove an indispensable work of reference. We have only detected one misprint, on page 53, where "50° Fahr." should no doubt have read 50°C.

We cannot close this notice without a word of praise for the excellent photograms of Mr. Pringle and Mr. Bousfield.

A. M.

ELECTRIC LIGHT CABLES.

Electric Light Cables. (London: Whittaker and Co., 1892.)

A DOZEN years ago, when dynamos and lamps, both arc and incandescent, had been pretty well developed, the general public arrived at the conclusion that it was time to commence the work of central station lighting by electricity. It was not until the plans of these proposed works were taken in hand by the consulting engineers that the difficulties in the way of distribution became fully apparent. It was not well known what strength of current could be safely carried through the conductors; and engineers were rather appalled at the cost of the copper required for maintaining uniform pressure over a district, and at the waste of energy in the conductors. Besides these theoretical troubles in the way, engineers were met by the practical difficulty of devising a secure and efficient means of laying conductors under the streets, and ensuring their proper insulation. Until recently, the rules which must be attended to by engineers to enable them to handle these questions were only to be found in scattered pamphlets and Proceedings of societies. Several scientific men dealt independently with the heating of the conductors, and finally Mr. Kennelly published his splendid experimental work on the subject. Other writers went fully into the economical principles which must be followed in order to secure the most uniform distribution at the least cost. When the alternating-current rendered the employment of high pressures both safe and convenient, many of these precautions became less necessary, but new problems arose which are also generally dealt with only in isolated papers. Inventors sprang up, each advocating his own system of laying mains, and an outsider can gain a knowledge of these only by reading the patent specifications, or by inspecting the progress of works. The mechanical details of making joints, insulating, and so forth, are not much dealt with in the literature of the subject.

The book before us is one of the first attempts to collect all the above principles within one binding. The first few chapters deal principally with the heating of conductors and the economical laws of distribution. Well-known writings on the subject are here condensed into convenient compass, and Kennelly's experimental results are given in sufficient detail. Series and parallel systems and their combinations, including the three-wire and five-wire systems, which serve so much to economise copper, are explained, and also the principles involved in the use of transformers with alternating currents. Having thus described the systems available, we have, in Chapter v., a useful account of the cost of cables and conduits, with tables showing the relative cost of different systems when the distribution extends to different distances, showing the advantages of using high pressure for long distances. Chapter vi. gives a number of practical data about different kinds of conductors and the manner of making joints, which, though not exhaustive, will be of use to many. The next chapters deal with the characters of the insulation, including air insulation, lead-covered cables, the various bituminous compounds known as bitite, &c., oil insulation, and, of course, vulcanized india-rubber, about which the author is particularly capable of giving information. The effects of capacity, which has given so much trouble at some central stations, are also alluded to. These chapters are very fairly written, and give as good an account of the various systems of insulation as is likely to be found anywhere, or as we might expect in a volume of this size, which is more a hand-book of the subject than an exhaustive treatise. Some of the principles of testing are then shortly, but very clearly, described; and the principles of house wiring are clearly shown, and safety devices described. Several good chapters come near the end of the book on the practical construction of lines, whether overhead or underground, the latter dealing chiefly with the actual work which has been done in London of late years.

This book is one of the best which could be taken up by the student to give him a general knowledge of what is involved in the comprehensive title—"The Distribution of Electricity." It does not pretend to be a complete manual for the office, containing all the information required by the consulting engineer in dealing with these problems, but the descriptions are clear and generally accurate, and the only criticism which we feel compelled to make is that sometimes, apparently with the desire of preventing the book from being too technical, or requiring too much mental effort to read it, the author has been, perhaps, a little too sketchy, and might with advantage have given

some more detailed information on a variety of points. Nevertheless, we consider that this book is a useful addition to electrical literature, and must be of the utmost use to students in showing the difficulties which have to be encountered in designing a plan of central station working. The general reader will also be much interested in learning something more of the meaning of the work which he sees being carried out at present in the streets of many of our towns. Should the book chance to fall into the hands of any members of electric lighting committees of Municipal Corporations, it will do a vast amount of good, by opening their eyes as to the number of problems that have to be considered in their dealings with different contractors, each generally wedded to a special system. It is to be hoped that this book will teach them that, in trying to act as consulting engineers without the special training necessary, they are not serving the best interests of the towns they represent. Altogether, "Electric Light Cables" is a useful addition to the literature of electrical engineering, and the absence of too many technicalities will make it popular with a large class of readers.

OUR BOOK SHELF.

Distribution de l'Electricité. I. "Installations isolées." II. "Usines centrales." Par R. V. Picou, Ingénieur des Arts et Manufactures. (Paris: Gauthier-Villars, 1892.)

THESE two small volumes are portion of a series belonging to "L'Encyclopédie scientifique des Aide-Mémoire," published under the direction of M. Léauté, Member of the Institute. The second volume is the only one which calls for remark. It deals with the methods, well known in England, of distribution of continuous and alternating currents and systems of high and low pressure. The information given concerning the multiphase and rotary current systems is very scanty and quite out of proportion to the other matters treated of. The reader will naturally look for an account of the method employed for the transmission of power from Lauffen to Frankfort, but he will find no information of any practical service. The author, however, gives a short discussion of the difficulties that must be surmounted if arc and incandescent lamps are to be installed on a circuit fed by a triphaser and three wires.

Information is given concerning the working of some of the principal existing central stations, and there is a useful bibliography.

Popular Readings in Science. By John Gall, M.A., LL.B., and David Robertson, M.A., LL.B., B.Sc. (Westminster: Constable and Co., 1892.)

THIS forms the second volume of Constable's Oriental Miscellany of original and selected publications, and is intended to form the basis of a general course of instruction in science, suited to the requirements of the pupils in Indian schools who are preparing for matriculation at the University. The authors lay no claim to originality, but have exercised a judicious choice in the selection of subject matter. The first chapter deals with meteorology, special prominence being given to Mr. Blandford's researches on the climate of India. Then follow chapters on the vegetable kingdom, evolution, both in its biological and chemical aspects, mimicry, the nebular hypothesis, tidal evolution, energy, the spectroscope, molecular forces, and Bacteria. A reference to the meteoritic hypothesis would make the chapter on the nebular theory more complete. The authors have wisely contented themselves with *descriptions* of theories and plain matter-of-fact statements. The book is very readable, but at times somewhat technical. It would, however, be improved by the addition of more diagrams, though it may be that more can safely be left to the imagination of the Oriental than the Western mind. The narrative style which has been adopted by the authors will make the book acceptable to general readers who are anxious to make acquaintance with modern science.

Geometrical Deductions, Book II. By James Blaikie and W. Thomson. (London: Longmans, Green, and Co., 1892.)

THIS treatise is intended to afford a systematic course of training in the art of solving geometrical problems. The basis of the system which the authors have employed is to be thoroughly recommended, being both logical and simple. The book is divided into sections, each of which consists of three parts. In the first a model deduction is fully worked out to illustrate the method of solution; then follow similar deductions with their figures, and occasional hints; while, lastly, the student is left to himself to solve the problems without any such aid. This principle is maintained throughout the entire book, so that a student should be able to obtain a good working knowledge and should also to a great extent be quite rid of a teacher.

The Appendices will also be found very useful, as they contain the enunciations of the propositions in Euclid's second book and of standard theorems and loci, together with a set of miscellaneous deductions covering the range of Euclid's first two books.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

B.A. Procedure.

THE coming meeting of our ancient and venerable institution, the British Association *for the Advancement of Science*, will doubtless be a large one, as the beauties of Edinburgh are sure to tempt many to attend, and may therefore give opportunity for discussion on a subject of fundamental importance—the future well-being of the Association and the means of retaining it as an object of veneration on account of the services which it *is* rendering and not merely on account of those which it *has* rendered.

It is beyond question that there are many who have long been dissatisfied, and who are of opinion that B.A. procedure is not in harmony with the times. Moreover, to speak plainly, many of us feel that the "tripper" element has become too predominant, and that the credit of science will suffer if a large number of persons be permitted, year after year, to make pleasant holiday, "supported by voluntary contributions," under the pretence of advancing science, while the number of true workers whose reputation alone upholds the claim of the Association to public recognition is but small.

In the great majority of instances the reading of papers on technical questions in the sections has become little less than a solemn and dreary farce played to almost bare benches; and it is only in exceptional cases—such as Section A affords—that a small and devoted body of true believers worship at an inner shrine without regard to the general public, and are thus able among themselves to do work of high value to science.

The B.A. should exercise an influence in two directions—it should advance scientific knowledge among scientific workers; and it should aid the general public in understanding and appreciating scientific work, its methods and results. It may effect the

former by bringing scientific workers together and giving them due opportunity for the interchange of knowledge and opinions. To secure this end, it is important that *sectional* and *intersectional discussions* should, in future, become *the feature* of the meetings, but to be successful these must be conducted with far greater forethought than heretofore—they must be true discussions and must not consist of a number of short papers written without reference to each other or to any central idea, and there must be no limitation of discussion so long as it is to the point. Probably the best plan will be that sectional committees, specially appointed for the purpose, select subjects, and that on each of these some one open a discussion by means of a carefully-prepared paper, printed and circulated at least a month beforehand, among those likely to take part in the debate. Such discussions should be carefully reported, and the edited report should be subsequently published, those who had taken part in the discussion having full liberty allowed them to give expression to their carefully-considered opinions instead of being required merely to punctuate their sentences in proof. The resolution not to report discussions arrived at last year by the Council is most unfortunate. If it were understood that discussions would be reported, speakers would be far more interested, and would take far more pains in preparing to take part in them than has hitherto been the case. It is, I think, unnecessary to dwell on the value of true discussion among workers in different, but cognate, branches of science.

As regards the public functions of the Association, it is unquestionable that much more might—and should—be done on behalf of those who are interested spectators rather than active workers in science. The evening lectures now delivered are often very brilliant expositions, but, as a rule, they have been "above the heads" of a very large proportion even of the members of the Association who have listened to them. I know many who think with me that a more direct effort should now be made to advance the knowledge of science among the general public at these meetings.

One great reform which *must* be carried out is the general curtailment of the expenses of the meetings, which make it impossible for any but the largest and richest towns to receive the Association. The lavish expenditure on the Reception Room which has been so frequently witnessed of late years should be unnecessary. So long as we can come together and can accomplish our object—the *advancement of science*—we should be satisfied with the most modest accommodation and should even be prepared to submit to some privation. At the German Naturforscher Versammlungen the vast majority cater for themselves, and private hospitality is almost unknown, the social demon, which is so ruthless a destroyer of much of the effectiveness of the B.A. meetings, being kept entirely in the background; and yet, in my opinion, these meetings are at least as enjoyable and fruitful of result as our own B.A. meetings.

Then we want younger presidents, on the average—men who are in their prime as scientific workers.

Of late years our Council has been far too cautious and conservative a body, and a large infusion of a liberal and progressive element is necessary if we are to set our house in order, so that it may suit the times. Many of us think that the Council is not in touch with us as a body—somehow we know of its existence, but its functions are mystic and akin rather to those of the Archives of the Royal Society than to those of an energizing and propulsive organ In these democratic days, it would be well if each section were to return a member to Council.

HENRY E. ARMSTRONG.

The Position of 4π in Electromagnetic Units.

THERE is, I believe, a growing body of opinion that the present system of electric and magnetic units is inconvenient in practice, by reason of the occurrence of 4π as a factor in the specification of quantities which have no obvious relation with circles or spheres.

It is felt that the number of lines from a pole should be m rather than the present $4\pi m$, that "ampere turns" is better than $4\pi n$C, that the electromotive intensity outside a charged body might be σ instead of $4\pi\sigma$, and similar changes of that sort; see, for instance, Mr. Williams's recent paper to the Physical Society.

Mr. Heaviside, in his articles in the *Electrician* and elsewhere, has strongly emphasized the importance of the change and the simplification that can thereby be made.

In theoretical investigations there seems some probability that the simplified formulæ may come to be adopted—

$$\mu \text{ being written instead of } 4\pi\mu, \text{ and } k \text{ instead of } \frac{4\pi}{K};$$

but the question is whether it is or is not too late to incorporate the practical outcome of such a change into the units employed by electrical engineers.

For myself I am impressed with the extreme difficulty of now making any change in the ohm, the volt, &c., even though it be only a numerical change; but in order to find out what practical proposal the supporters of the redistribution of 4π had in their mind, I wrote to Mr. Heaviside to inquire. His reply I enclose; and would merely say further that in all probability the general question of units will come up at Edinburgh for discussion. OLIVER J. LODGE.

Paignton, Devon, July 18, 1892.

MY DEAR LODGE,—I am glad to hear that the question of rational electrical units will be noticed at Edinburgh—if not thoroughly discussed. It is, in my opinion, a very important question, which must, sooner or later, come to a head and lead to a thoroughgoing reform. Electricity is becoming not only a master science, but also a very practical science. Its units should therefore be settled upon a sound and philosophical basis. I do not refer to practical details, which may be varied from time to time (Acts of Parliament notwithstanding), but to the fundamental principles concerned.

If we were to define the unit area to be the area of a circle of unit diameter, or the unit volume to be the volume of a sphere of unit diameter, we could, on such a basis, construct a consistent system of units. But the area of a rectangle or the volume of a parallelepiped would involve the quantity π, and various derived formulæ would possess the same peculiarity. No one would deny that such a system was an absurdly irrational one.

I maintain that the system of electrical units in present use is founded upon a similar irrationality, which pervades it from top to bottom. How this has happened, and how to cure the evil, I have considered in my papers—first in 1882-83, when, however, I thought it was hopeless to expect a thorough reform; and again in 1891, when I have, in my "Electromagnetic Theory," adopted rational units from the beginning, pointing out their connection with the common irrational units separately, after giving a general outline of electrical theory in terms of the rational.

Now, presuming provisionally that the first and second stages to Salvation (the Awakening and Repentance) have been safely passed through, which is, however, not at all certain at the present time, the question arises, How proceed to the third stage, Reformation? Theoretically this is quite easy, as it merely means working with rational formulæ instead of irrational; and theoretical papers and treatises may, with great advantage, be done in rational formulæ at once, and irrespective of the reform of the practical units. But taking a far-sighted view of the matter, it is, I think, very desirable that the practical units themselves should be rationalized as speedily as may be. This must involve some temporary inconvenience, the prospect of which, unfortunately, is an encouragement to shirk a duty; as is, likewise, the common feeling of respect for the labours of our predecessors. But the duty we owe to our followers, to lighten their labours permanently, should be paramount. This is the main reason why I attach so much importance to the matter; it is not merely one of abstract scientific interest, but of practical and enduring significance; for the evils of the present system will, if it continue, go on multiplying with every advance in the science and its applications.

Apart from the size of the units of length, mass, and time, and of the dimensions of the electrical quantities, we have the following relations between the rational and irrational units of voltage V, electric current C, resistance R, inductance L, permittance S, electric charge Q, electric force E, magnetic force H, induction B. Let x^2 stand for 4π, and let the suffixes $_r$ and $_i$ mean rational and irrational (or ordinary). Also let the presence of square brackets signify that the "absolute" unit is referred to. Then we have—

$$x = \frac{[E_r]}{[E_i]} = \frac{[V_r]}{[V_i]} = \frac{[H_r]}{[H_i]} = \frac{[B_r]}{[B_i]} = \frac{[C_i]}{[C_r]} = \frac{[Q_i]}{[Q_r]}.$$

$$x^2 = \frac{[R_r]}{[R_i]} = \frac{[L_r]}{[L_i]} = \frac{[S_i]}{[S_r]}.$$

The next question is, what multiples of these units we should take to make the practical units. In accordance with your request I give my ideas on the subject, premising, however, that I think there is no finality in things of this sort.

First, if we let the rational practical units be the same multiples of the "absolute" rational units as the present practical units are of *their* absolute progenitors, then we would have (if we adopt the centimetre, gramme, and second, and the convention that $\mu = 1$ in ether)

$$\begin{aligned} [R_r] \times 10^9 &= \text{new ohm} = x^2 \text{ times old.} \\ [L_r] \times 10^9 &= \text{new mac} = x^2 \quad ,, \quad ,, \\ [S_r] \times 10^{-9} &= \text{new farad} = x^{-2} \quad ,, \quad ,, \\ [C_r] \times 10^{-1} &= \text{new amp} = x^{-1} \quad ,, \quad ,, \\ [V_r] \times 10^8 &= \text{new volt} = x \quad ,, \quad ,, \\ 10^7 \text{ ergs} &= \text{new joule} = \text{old joule.} \\ 10^7 \text{ ergs per sec} &= \text{new watt} = \text{old watt.} \end{aligned}$$

I do not, however, think it at all desirable that the new units should follow on the same rules as the old, and consider that the following system is preferable :—

$$\begin{aligned} [R_r] \times 10^8 &= \text{new ohm} = \frac{x^2}{10} \times \text{old ohm.} \\ [L_r] \times 10^8 &= \text{new mac} = \frac{x^2}{10} \times \text{old mac.} \\ [S_r] \times 10^{-8} &= \text{new farad} = \frac{10}{x^2} \times \text{old farad.} \\ [C_r] \times 1 &= \text{new amp} = \frac{10}{x} \times \text{old amp.} \\ [V_r] \times 10^8 &= \text{new volt} = x \times \text{old volt.} \\ 10^8 \text{ ergs} &= \text{new joule} = 10 \times \text{old joule.} \\ 10^8 \text{ ergs per sec.} &= \text{new watt} = 10 \times \text{old watt.} \end{aligned}$$

It will be observed that this set of practical units makes the ohm, mac, amp, volt, and the unit of elastance, or reciprocal of permittance, all larger than the old ones, but not greatly larger, the multiplier varying roughly from $1\frac{1}{4}$ to $3\frac{1}{2}$.

What, however, I attach particular importance to is the use of one power of 10 only, viz. 10^8, in passing from the absolute to the practical units; instead of, as in the common system, no less than four powers, 10^1, 10^7, 10^8, and 10^9. I regard this peculiarity of the common system as a needless and (in my experience) very vexatious complication. In the 10^8 system I have described, this is done away with, and still the practical electrical units keep pace fairly with the old ones. The multiplication of the old joule and watt by 10 is, of course, a necessary accompaniment. I do not see any objection to the change. Though not important, it seems rather an improvement. (But transformations of units are so treacherous, that I should wish the whole of the above to be narrowly scrutinized.)

It is suggested to make 10^9 the multiplier throughout, and the results are :—

$$\begin{aligned} [R_r] \times 10^9 &= \text{new ohm} = x^2 \times \text{old ohm.} \\ [L_r] \times 10^9 &= \text{new mac} = x^2 \times \text{old mac.} \\ [S_r] \times 10^{-9} &= \text{new farad} = x^{-2} \times \text{old farad.} \\ [C_r] \times 1 &= \text{new amp} = \frac{10}{x} \times \text{old amp.} \\ [V^r] \times 10^9 &= \text{new volt} = 10x \times \text{old volt.} \\ 10^9 \text{ ergs} &= \text{new joule} = 10^2 \times \text{old joule.} \\ 10^9 \text{ ergs p. sec.} &= \text{new watt} = 10^2 \times \text{old watt.} \end{aligned}$$

But I think this system makes the ohm inconveniently big, and has some other objections. But I do not want to dogmatize in these matters of detail. Two things I would emphasize :— First, rationalize the units. Next, employ a single multiplier, as, for example, 10^8.

OLIVER HEAVISIDE.

P.S.—Heaven preserve us from dynamics based on the Act of Parliament!

Neutral Point in the Pendulum.

IN the theory of the pendulum the position of the neutral point of support is a matter of practical importance, which is, nevertheless, quite disregarded.

Taking a rigid uniform bar as the simplest case, there are four points of support from which its vibrations are equal, the two ends and the two respective centres of oscillation. But there are two symmetric points, situated between either end and the centre of oscillation nearest to that end, from which points of suspension the rate of vibration is most rapid. Hence, when suspended from these points, a change in the position of the point of support produces a minimum difference in the rate of vibration. Or, in practical terms, there is a great advantage in having a small amount of overhead weight above the support, as then, if the support approach the bob (owing to changes in elasticity of the spring, or wear of knife edges), and so increase the number of vibrations, it recedes from the top weight, and so diminishes the vibrations to a corresponding amount, and *vice versa*.

This neutral point of support seems to have been overlooked in the main pendulum researches, as it was what had to be avoided rather than sought in the determination of the length, which was then the main interest. Probably some one has already noticed such an elementary property; but it is of so much value in minimizing sources of error that it is worth some attention.

Bromley, Kent. WM. FLINDERS PETRIE.

Induction and Deduction.

CAN we determine the precise relation between Induction and Deduction? Both are said to be a species of Inference. *Deduction* is, no doubt, Mediate Inference. Is *Induction* Mediate or Immediate Inference? If Immediate it must be of the form :

This X is Y (or these X's are Y's) . . . . . (1)
∴ All X's are Y's . . . . (2)

But such "inference" as this is not illative; (1) can furnish only a suggestion, not by any means a justification, of (2).

Still it is true that if, *e.g.* I have proved that the angles at the base of an isosceles triangle are equal to each other, I henceforth believe and assert unhesitatingly, that *all* isosceles triangles have the angles at the base equal. *How* do I justify such a conclusion of an universal from a particular? In this way, I think :—Every nameable or cogitable object is an identity in diversity—that is, it is itself, it is *something*, and it has a plurality of characteristics. This principle is involved in the assertion of any statement of the form *A is* B, and it seems moreover to be, in itself, evident on reflection. Further (as Bacon surmised), every property (or group of properties) has a "form," some invariable and inevitable coexistent. In other words, there is uniformity of coexistence as well as of causation in nature. In the case of any one isosceles triangle, I have *seen* the connection of interdependence that there is between the characteristics of "having equal sides," and "having the angles at the base equal;" I have perceived it to be self-evident that the one property involves the other. Hence, my whole argument might run thus :—

Every characteristic is invariably accompanied by some other characteristic;

Equality of sides in a triangle is a characteristic;

∴ Equality of sides in a triangle is invariably accompanied by some other characteristic.

Again :—

Equality of angles at the base is a characteristic which is (self-evidently) inseparable from equality of sides in one [this particular] case;

What is inseparable from equality of sides in one case is inseparable in all cases;

∴ Equality of angles at the base is inseparable from equality of sides in all cases—

That is, *all* isosceles triangles have the angles at the base equal.

What we rely on here is Interdependence of characteristics and Uniformity of that interdependence; *i.e.* we rely on a principle of coexistence or coinherence, parallel to Mill's "Law of Causation"; and this is a principle which we find to be a necessary condition of what we accept as strictly self-evident propositions. The assertion with which we conclude in the above generalization, is an assertion of uniformity of interdependence between certain specified characteristics.

Again, if I administer a certain amount of arsenic to a healthy animal, and it dies, and I hence conclude that arsenic is a cause

of death, I argue thus:—Since every event (= change of attributes in subjects) has a cause, the death in question had a cause; the only precedent event that was relevant, was the administration of arsenic, therefore the arsenic was in this case the cause of death (this last result is obtained by the Method of Difference—by it we prove cause—*i.e.* interdependence of successive events). But (by the principle of uniformity) if arsenic is on one occasion cause of death, it is always cause of death; therefore arsenic is always a cause of death.

It will be observed that in this second induction, though not in the first, we make use of one of Mill's "Inductive Methods." The function of these Methods is to prove interdependence between phenomena—whether it be an interdependence of concomitance or of causation. In the case of the Method of Difference we proceed on the assumption that if the introduction of A is followed by the appearance of C, or the removal of A by the disappearance of C, then A and C are causally interdependent. In the Method of Agreement we proceed on the assumption that if A is never found without C, A has a connection of interdependence with C.

We do not use, and do not need, these Methods in mathematical generalizations, because there we *see* the interdependence upon which generalization to unknown cases is based; it is this actual apprehension of interdependence that both makes the methods unnecessary and gives mathematical generalizations the peculiar certainty which is generally attributed to them. In the case above cited, for instance, we *see* that equality of angles at the base is self-evidently and necessarily bound up with equality of sides in a triangle. We do *not* see that there is a self-evident interdependence between the obvious properties of arsenic and poisonousness.

A further interesting point is that our power of predicting that one event, A, will be *followed* by another event, C, seems to depend wholly upon *coexistence* of attributes in the subjects concerned. If we have seen one animal dosed with arsenic and subsequently die, and hence conclude that another animal called by the same name, and dosed with an equal amount of arsenic, will die, is not our inference based upon the assumption of a certain constant coinherence of attributes, both in the animal and in the poison—a coinherence of such a kind that when the two subjects are so collocated as to act upon each other, a result similar to that produced in the first case will be produced in the second also? If the properties of this arsenic are different from the other, or if the second animal, though looking like the first, has a different internal constitution, there is no reason why death should result. Hence, laws of succession in events seem to depend upon laws of coexistence of attributes in subjects.

Even those generally unquestioned axioms of logic, the Law of Contradiction and the Law of Excluded Middle, might be appealed to (if it were necessary) in support of the Principle of Interdependence—for the Law of Excluded Middle intimates a thoroughgoing connection (positive or negative) between all nameable things; and the Law of Contradiction asserts a certain definite amount of necessary interdependence of properties in every imaginable case—interdependence, namely, between *the presence of any characteristic* and *the absence of its negative.*

Looking at the whole process of inductive reasoning, it appears to be in the application of the "Methods" that the principles used approach nearest to the character of mere assumptions; and this is so only because of the difficulty of applying the Methods precisely—of being sure, *e.g.* in the case of the arsenic, that the administration of arsenic *was* the only new antecedent relevant to death.

It may just be noticed that in an argument by analogy we rely upon an interdependence which is inferred from the complexity or amount of interdependence already known or supposed.

If the above account of inductive reasoning is accepted, it appears that the connection between Induction and Deduction is very close—in fact, that the one distinctive feature of logical induction is the element of hypothesis or discovery—the supposition of a given connection—from which every Induction must set out.

Cambridge. E. E. CONSTANCE JONES.

The Scale for Measurement of Gas Pressures.

I VENTURE to ask you to print the following suggestion. It is one likely enough to have been made before, but I do not remember having met with it.

We generally measure gaseous pressures in millimetres of mercury, and 760 mm. is adopted as the standard pressure. It would certainly be more convenient if we expressed the measurement in degrees, the degree being of such magnitude that the standard pressure were 273°. All calculations involving change of P, T, and V to or from the standard conditions would be simplified in an obvious way. The equation $PV = RT$ would become $V = R$ at standard pressure and temperature. R being the same constant for all gases under all conditions, if V stand for the molecular volume, it would be convenient to remember it as identical with the well-known number expressing the standard volume of a gramme-molecule. 1°P would correspond to about 2·78 mm. or $\frac{1}{9}$ inch of mercury.

ORME MASSON.

The University of Melbourne, June 21.

Luminous Clouds.

BRIGHT luminous clouds were seen here on the night of Sunday the 24th inst., in the north and north-north-east, from 9.35 to 10.35 p.m. As usual they distinctly resembled *cirri*, having some definite upward curls. The actual cirri, which had after sunset been moving rapidly from east-south-east, now appeared dusky against the twilight glow. The filature of the upper or luminous cirri was, as appears to be usual, west and east, while that of the ordinary cirri was east-south-east and west-north-west.

These luminous clouds, although no doubt simply reflecting solar light, generally appear to the casual observer as incandescent or self-luminous.

They were seen from the summit of Ben Nevis all through the night of the 24th–25th, according to the report in the *Times*.

Lutterworth. W. CLEMENT LEY.

Whirlwinds in the South Indian Ocean.

THE following account of whirlwinds met with in the South Indian Ocean at the end of last May, which has been supplied to the Meteorological Office by Messrs. Sandbach, Tinne & Co., of Liverpool, may be of interest to your readers.

ROBERT H. SCOTT,
July 22. Secretary, Meteorological Office.

Extract from a Letter received from Capt. S. P. Hearn, Ship "Genista."

"At noon on May 26, lat. 42° 0′ S., long. 99° 0′ E., wind fresh from N.W.—weather very squally with rain, barometer steady at 29·82 in., thermometer 49° since midnight. A very heavy black squall with rain began to rise in the W. Barometer suddenly fell 0·1 in. As the squall neared the ship it arched up in the centre, showing a very bright blue sky at the back of it; the ends of the squall on either side were quite black and thick with rain. On its nearer approach to the ship I saw two immense whirlwinds, just a little on either side of the centre of the arch and coming direct for the ship, the sea under and near the whirls being carried around and up in great volumes. I thought at first they were two waterspouts forming, but I saw no descending column or clouds from above, as is seen when a waterspout is forming; when these whirls came to within two miles of the ship, the squall seemed to part in the centre of the arch—one half passing to the N.E., the other half to the S.E., one whirl following in rear of each part of the squall, and not where the clouds were heaviest. During the time of the separation of the arch we had the wind very unsteady from N.W. to S.W. There was only a fresh breeze with thick rain in that part of the squall that neared the ship; yet the squall was travelling along at a great rate, the whirls keeping in the rear till out of sight. I shortened sail to topsails as soon as I saw the squall rising. After it passed, the weather looked very fine, bright, and clear, but the sky was a windy one, being a very bright blue. By 3 p.m. the wind shifted to W., and barometer had fallen to 29·67 in., thermometer 48°. At 4 p.m. saw another whirl passing along to windward in the rear of a squall, the clouds above it being twined and twisted every way. During the whole night we had very heavy squalls, sometimes following one another very quick, with little wind between—direction W.S.W. At daylight the weather was much finer. After that, to lat. 40° 22′ S., long. 125° E., I had very peculiar

weather. Wind from N.W. to S. and back again, from a light breeze to a moderate gale, barometer never rising higher than 29·90 in., or falling below 29·66 in.

The Cause of the Great Fire at St. John's.

A FEW days ago you inserted a letter calling attention to the large number of fatal accidents occurring every year caused by the upsetting of paraffin lamps, the great majority of which could easily be prevented if the use of automatic extinguishers were made compulsory.

Now we are startled by the report of the huge conflagration at St. John's, which, in addition to having caused terrible and widespread suffering, has resulted in the loss of a large amount of property, valued at many millions of dollars.

Amongst the principal sufferers by this great fire are some of the leading English insurance companies, and various estimates have been published of the amounts which they will lose by this great fire. *The Policy Holder*, an insurance journal, in its last issue, mentions the following figures:—

	£		£
Phœnix	120,000	to	140,000
Royal	80,000	to	100,000
Liverpool, London, and Globe	50,000	to	70,000
London and Lancashire ...	50,000	to	60,000
Commercial Union	40,000	to	50,000
North British and Mercantile	50,000	to	60,000
Northern	40,000	to	50,000
Manchester	8,000	to	11,000
Lancashire	5,000	to	7,000
Norwich Union	7,000	to	10,000

Also the "General," said to be £30,000, and the "Lion" for a comparatively large sum, making in the aggregate a loss for English insurance companies alone of over £500,000 sterling.

The same journal explains how this great fire was brought about:—

"It is worthy of note that, like the Chicago fire, this conflagration was caused by the upsetting of an oil lamp in a stable. Fire business was already this year going badly enough, and there now seems little reason to doubt that to the companies as a whole 1892 will prove a disastrous year and a dead loss."

The Mayor of Manchester (Alderman Bosdin Leech), in presiding yesterday at a meeting of citizens called for the purpose of raising a fund in aid of the sufferers by this great catastrophe, stated—

"Since the fire of forty or fifty years ago many substantial public and private buildings had been erected, all of which have been destroyed. On one side, at any rate, a thriving town had been reduced to a heap of ashes, and about 10,000 people had been rendered homeless, and damage had been done to the extent of about 2,500,000 dollars. With such an event coming suddenly upon them, they could imagine how the people were prostrated. The heart of the people was completely crushed. A great many of the sufferers were of the poorest class, and they were almost powerless to help themselves. They were without food, except such as had been supplied to them through the kindness of their neighbours; they were without clothes, for all their clothes had been destroyed; and, unfortunately, the working people of the community had been almost entirely bereft of the tools and implements with which they were in the habit of earning their daily bread."

It is indeed very sad to think that this terrible calamity might have been avoided had the oil lamp which was the cause of all this mischief been fitted with a simple application of science in the shape of a simple automatic extinguisher.

July 20. HUMANITY.

THE WASHINGTON COLLECTION OF FOSSIL VERTEBRATES.

WE are pleased to learn from a transatlantic contemporary that the enormous collections of vertebrate remains, obtained under the superintendence of Prof. O. C. Marsh from the Tertiary and Secondary strata of the north-western United States, are about to be transferred to the National Museum at Washington, where they will eventually be properly arranged, and exhibited to the public. For the last nine years, as we are informed, the United States Government has voted funds for the collection and preservation of these wonderful remains, descriptions of which have been from time to time presented to the scientific world with a wealth of illustration which cannot but render European palæontologists somewhat envious.

Hitherto the whole of this collection (together with Prof. Marsh's private collection) has been stored in the palæontological department of the unfinished Peabody Museum, at Yale College, New Haven, Conn.; where want of space has totally prohibited its proper exhibition. Indeed, those who have had the opportunity of inspecting this unrivalled series inform us that the specimens are so crowded together—the smaller ones in tier upon tier of trays, and the larger ones on the floors and in every available corner—that it has hitherto been quite impossible to form any adequate judgment as to the extent and importance of the collection. It is, however, satisfactory to learn that the whole series has been carefully labelled and registered, so that the locality and date of acquisition of every individual bone are fully recorded.

To prepare such an enormous collection for transit by rail is a work demanding both extreme care and a considerable amount of time; while the Museum space required for the exhibition of entire skeletons of the bulk of those of the Jurassic and Cretaceous Dinosaurs must be proportionately extensive. We are informed, indeed, that if the whole collection were transferred to Washington at the present time it would occupy fully one-half of the buildings of the National Museum. Accordingly, only a portion of it is to be immediately transported; while the remainder is to wait until Congress has provided suitable quarters for its reception. It is to be hoped that the moiety now to be transferred will include a representative selection from the entire series, so that palæontologists will have an opportunity of seeing more or less nearly entire skeletons, not only of the Dinosaurs and other huge Saurians of the Mesozoic, but likewise those of the equally wonderful Tertiary mammals. We may also venture to express the hope that the United States Government will before long see its way to enriching European Museums with some of their duplicate specimens, of which there must be a large number for disposal.

With a wise liberality, the Government of the United States appears to have made a regular business of the collection of these fossils, under the able direction of Prof. Marsh; this business being conducted much after the manner of any other mining enterprise. One of the favourite hunting-grounds is the region lying between the "Rockies" and the Wasatch Mountains; and the accounts of the richness of some of these deposits in vertebrate remains is absolutely marvellous. Thus Prof. Marsh is reported to know of one small valley where bones of Mosasaurians are in such profusion that in passing through it he observed at one time no less than six entire skeletons of these monstrous reptiles, each averaging some 80 feet in length. At such a rate of discovery it is no wonder that Museum accommodation cannot be procured fast enough. The care taken to prevent other fossil-hunters from discovering the more productive localities affords rather amusing reading; but, under the circumstances, it is, perhaps, natural.

Whenever a likely-looking bone or skeleton is seen projecting from a rocky cliff, skilled workmen are at once set to work on its extraction; a single specimen sometimes leading to the discovery of a regular golgotha of remains. The wonderfully perfect condition of some of these fossils, and the rapidity with which the carcasses of their former owners must have been entombed in sand

or mud, are brought prominently under notice by a recent reported discovery in Wyoming. This is said to be nothing less than the disentombment of an entire skeleton of that stupendous Dinosaur known as the Brontosaur, in which not only is every bone in place, but an actual mould of the surface of the eye, formed in the sand upon which the creature lay, has been preserved in the solid rock.

Prof. Marsh's restoration of the Brontosaur—a creature 60 feet in length, walking on all fours, with an enormously long neck and tail, a disproportionately small head, and the bony substance of its backbone reduced to a mere shell and a honeycombed interior—has been long before the world. Less known, however, is his later reconstruction of the skeleton of one of the gigantic horned Dinosaurs from the Laramie Cretaceous, which he calls *Triceratops*; the skull and pelvis of which were referred to in an earlier number of NATURE. In this restoration the Professor has certainly succeeded in producing a most marvellous animal, although, so far as we see, the figure appears to be true to nature. It will be remembered that one of the most remarkable features in the skull of *Triceratops* (which in some specimens was upwards of 12 feet in length) is the production of the hinder region into a huge fan-like shield, the use and purpose of which it was at first a little difficult to understand. This is, however, explained by the restored skeleton, where we see this shield overlapping and protecting the first six vertebræ of the neck; to which additional strength was imparted by the bony union of several of them. In the shortness of its neck and the enormous size of its skull, *Triceratops* presents a striking contrast to *Brontosaurus*. Like the latter, however, it habitually walked on all fours; while in correlation with its massive skull its fore-limbs were relatively stouter than in any other Dinosaur. In this respect it differs widely from its near ally, *Stegosaurus*, which, at least occasionally, walked in a bird-like manner; and since *Triceratops* is evidently a more specialized creature than *Stegosaurus*, the suggestion arises that the former has undergone a retrograde development from a bipedal to a quadrupedal mode of progression. No attempt has yet been made to represent the position on the skeleton of the dermal bony armour with which many parts of the body of *Triceratops* were protected during life; the precise position of the various spines, knobs, and plates, which have been found in association with the bones, being largely a matter of conjecture. The size in life of the restored example would be approximately some 25 feet in length by 10 in height; but these dimensions must have been exceeded by other specimens.

By the completion (so far as anything connected with fossils can be said to be complete) of our knowledge of the skeleton of *Triceratops*, we are acquainted with the bony framework of all the chief types of Dinosaurian reptiles at present known. These may be classed as the Sauropodous type, as represented by *Brontosaurus*; the Theropodous type, as represented by *Megalosaurus* and its allies; and the Ornithopodous modification, represented on the one hand by *Iguanodon*, and on the other by *Stegosaurus*, *Triceratops*, &c.

In the contemporary publication to which we have referred some interesting suggestions as to the probable habits of these Dinosaurs are put forth, although how far they will meet with acceptation remains to be seen. Thus it is suggested that the honeycombed vertebræ of the Brontosaurs and their allies were filled with warm air from the lungs (which assumes that these reptiles were warm-blooded), by which means their bodies were partly floated when they wandered out of their depth in the sea shallows, from whence they stretched their long necks to crop the seaweed near the shore. Again, the long hind legs of the Hadrosaur (an ally of our Iguanodon) are considered to have enabled their owner to wade far out to sea in search of seaweeds growing on the ocean-floor; while the armoured kinds, like *Stegosaurus* and *Triceratops*, are considered to have been essentially terrestrial.

As we have indicated, the great bulk of the collection is composed of Secondary reptiles and Tertiary mammals; and from their large size it is these which form its most striking feature. We most not omit to state, however, that it also contains the Toothed Birds from the Cretaceous of Kansas (of which our English collections do not at present possess a single bone), as well as hosts of teeth of Mesozoic mammals, although we have no definite information as to what proportion of these are the property of the State, and what belong to Prof. Marsh. Then, again, scattered among the trays and drawers more especially devoted to the remains of mammals and reptiles is an extensive collection of fish-remains from Cretaceous and Tertiary strata, and especially from the Green River Eocene shales of Wyoming, most of which we believe to be at present totally undescribed.

Space prevents us from saying more as to the extent of this marvellous collection—a collection which, with others from the same regions, has done more in ten years to revolutionize our classifications, and to give us a definite knowledge of many groups of animals previously known by battered fragments, than would have resulted from half a century's work upon European materials. We may, however, conclude by offering our hearty congratulations to the Governments of the United States and to Prof. Marsh, who have succeeded, by the liberality of the one and the untiring energy of the other, in amassing this magnificent collection, which is now, for the first time, in a fair way to be exhibited in a manner befitting its value and importance. Prof. Marsh's magnificently illustrated monographs on the Toothed Birds and the Dinocerata are splendid examples of how a collection like this ought to be made known to the scientific world at large; and we trust ere long to be able to welcome his long-promised volumes on the Dinosaurs and the Brontotheres, which will render its riches yet better known.

R. LYDEKKER.

DYNAMO-ELECTRIC MACHINERY.[1]

THIS is the first part of a treatise dealing with dynamo-electric machinery and its applications, and comprises the theory and practical construction of dynamos and motors, and an account of instruments and methods of electrical measurement. Such subjects as the fusion and welding of metals by electricity and the transmission of power are reserved for a second part, to be issued in the autumn of the present year.

The author begins with a chapter entitled "Generalities regarding Dynamos," in which he discusses the early rudimentary magneto-machines of Pixii and Clarke, and the multipolar machines of the same class invented by Stöhrer and Niaudet, gives a general explanation of the self-excitation and action of series of shunt and compound dynamos, and describes the various typical forms of armature used in constant and alternating-current machines. In this part there is room for little novelty of treatment; the author could only endeavour to be impartially historical and clearly descriptive, and give as complete and useful an account of the more important examples of dynamo machinery as his space would admit of. In this Signor Ferrini seems to have succeeded very well. He does not weary his readers with descriptions of mere antiquities, but supplies only such a brief account of earlier forms as is sufficient to enable the reader to trace the evolution of the modern constant-current dynamo, with its beautiful balance and inter-relation of

1 "Recenti Progressi nelle Applicazioni dell' Elettricità di Rinaldo Ferrini." Parte Prima: Delle Dinamo. (Milano: Ulrico Hoepli, 1892.)

parts, from the rudimentary, uneconomical, and violently periodic machine of twenty years ago, or to compare the powerful alternator of the present day with the ineffective and wasteful toy instrument, which used to figure in cabinets of apparatus and the older books on electricity.

Chapter ii. deals with magnetic induction, and chapter iii. with the induction of currents by the motion of conductors in a magnetic field. These extend over almost 100 pages, or about one-fourth of the whole volume, a space none too large for the subject, but perhaps a little out of proportion to that devoted to dynamo machinery, which is still further restricted by the allocation of fifty pages in chapter iv. to methods of measurement.

Signor Ferrini's treatment of the theoretical part of his subject seems on the whole marked by completeness and accuracy. He has evidently given careful attention to the late developments of magnetic research, and in his chapter on measurements has included most of the improvements recently made, such, for example, as the methods of measuring power, &c., in the circuits of alternators and transformers which have been invented by Ayrton and others. No mention is made, however, of Blakesley's ingenious "split dynamometer" method for transformers, and determining the difference of phase of two alternating currents. Nor is the method (p. 171) of finding the true mean activity in an alternating current from the apparent activity attributed to its inventor, Prof. Ayrton.

We notice here a few points which have occurred to us in looking over this part of the book as perhaps calling for remark. First of all with respect to the definition of a uniform magnetic field given at p. 58, it may be noticed that if the numerical value of the intensity of the magnetic force be the same at all points of a finite space, its direction must be the same at all points of the same space, and that the intensity cannot vary in magnitude from point to point without varying also in direction, and *vice versâ*. This does not seem to be generally understood, at any rate it is common to define a uniform field as one for which the magnitude *and the direction* of the magnetic force are the same at every point. That the former implies the latter, and the latter the former, may be seen by considering a closed surface formed by a portion of a tube of force, in the field, intercepted between two equipotential surfaces. The cross-sections at the two ends must have the same area, since the magnetic force at each end is the same. Further, the lines must be straight, for if they be supposed curved, the portion of the tube may be taken so that it is concave on one side and convex on the other. The line-integral of magnetic force round a closed circuit, taken along the convex and concave sides and across the ends, vanishes But nothing is contributed to it by the ends of the tube. Hence the magnetic force along the convex side must be on the whole less than that along the shorter concave side, which contradicts the supposed uniformity of magnitude of the field-intensity.

At p. 66 difference of potential, $V_1 - V_0$, between two points is defined as the work which must be done against magnetic forces in carrying a *unit* magnetic pole from the point of lower to that of higher potential; and at p. 74, where the field of a solenoid is considered, $-dV/dx$ appears as the force on a pole of strength m.

At p. 81 mention might have been made of the influence of mechanical stress and disturbance on the magnetization of iron observed by Lord Kelvin and others, and of the fact that very much higher permeabilities than the 2000 quoted from Rowland's experiments have been obtained by Ewing for soft iron subjected to molecular vibration produced by tapping.

The subject of hysteresis is dealt with at p. 91, and again at p. 235 in the chapter on the construction of a continuous-current dynamo. In the latter place a proof is furnished of the well-known formula given by Warburg in 1881 or 1882, and a little later by Ewing, for the energy dissipated in a closed cycle of magnetization. In the course of that proof, to which in itself we take no exception, one or two statements are made which, if we have understood the author aright, are erroneous. It is stated that when the integral induction Φ through each turn of a magnetizing helix of n windings, each carrying a current c, is increased by an amount $d\Phi$, a quantity of energy $= -ncd\theta\ (= -v\mathbf{H}d\mathbf{B}/4\pi)$, where v is the volume of the medium magnetized, $\mathbf{H}$ the field intensity and $\mathbf{B}$ the induction, both supposed uniform) is given out by the spiral *and converted into heat*. Now (the sign being left out of account) this is certainly the energy sent into the field from the battery or generator, but it is not the case that it is all converted into heat. The amount of energy spent in unit volume of the magnetized medium is $\mathbf{H}d\mathbf{B}/4\pi$, but of this $(\mathbf{H}d\mathbf{B} + \mathbf{B}d\mathbf{H})/8\pi$ goes to increase the electrokinetic energy, the amount of which per unit volume of the medium is $\mathbf{BH}/8\pi$. The total amount of energy spent per unit volume in the cycle of magnetization, otherwise than in increasing the electrokinetic energy, is therefore

$$\frac{1}{4\pi}\int \left\{ \mathbf{H}d\mathbf{B} - \frac{1}{2}(\mathbf{H}d\mathbf{B} + \mathbf{B}d\mathbf{H}) \right\},$$

the integrals being taken round the cycle. (It is to be noticed that this balance of energy may be negative, and in that case energy is taken from the field to make up the increase of electrokinetic energy.[1])

But for a closed cycle

$$\int (\mathbf{H}d\mathbf{B} + \mathbf{B}d\mathbf{H}) = 0,$$

and hence the energy spent is

$$\frac{1}{4\pi}\int \mathbf{H}d\mathbf{B}.$$

This must have been dissipated, since the medium at the end of the cycle has returned to the same state as at first.

No affirmation can be made as to what becomes of the balance of energy, except with reference to a closed cycle.

Again, at p. 237 it is stated that if $\mathbf{H}_1, -\mathbf{H}_1$, be limits of $\mathbf{H}$ corresponding to limits $\mathbf{B}_1, -\mathbf{B}_1$ of $\mathbf{B}$,

$$\int_{-\mathbf{H}_1}^{\mathbf{H}_1} \mathbf{H}d\mathbf{B} = \int_{-\mathbf{B}_1}^{\mathbf{B}_1} \mathbf{B}d\mathbf{H}.$$

This is certainly not correct, as may be easily seen by representing the integrals graphically, or by considering that taken round a closed cycle

$$\int \mathbf{B}d\mathbf{H} = -\int \mathbf{H}d\mathbf{B},$$

since

$$\int (\mathbf{H}d\mathbf{B} + \mathbf{B}d\mathbf{H}) = \int d(\mathbf{BH}) = 0$$

for the cycle.

This error, a mere oversight no doubt, has appeared more than once in connection with this subject, and an erroneous demonstration founded on it and a mistaken identification of the energy dissipated with the electrokinetic energy, has been used by more than one writer.

The chapters on the "Continuous Current Dynamo," the "Dynamo in Action," and "Alternating Dynamos," are excellent in many respects. The subject is well and fairly comprehensively treated, and the very useful notion of the magnetic circuit has been employed throughout with good effect. Some well-known machines do not seem to be described, for example, the Victoria among

[1] See a paper by the writer in the *Phil. Mag.*, December 1890.

continuous-current machines, and the latest form of Mordey's alternator.

The inclusion of a larger number of thoroughly practical examples of dynamo specification and construction would also be an improvement.

On the whole, Signor Ferrini's book seems the outcome of an earnest endeavour to give an accurate and full account in moderate compass of an important and difficult subject. It will be more easy to judge of the full measure of the author's success when the work is completed. In any case the book seems likely to be a credit to Italian technical literature.

A. GRAY.

MR. A. NORMAN TATE.

BY the death of Mr. A. Norman Tate, F.I.C., Liverpool has lost one of her most prominent citizens and men of science. It is not only as an able analytical chemist that Mr. Tate will be missed by a large section of the public to whom his genial presence was familiar, but as a scientific teacher and pioneer of the technical education movement in Lancashire, his place is one that will not easily be filled. For some time past Mr. Tate has had indifferent health, and has had to give up much of his active work in connection with the Society of Chemical Industry, of whose Publication Committee he was a member, and the numerous local and other learned societies to which he gave great aid. Latterly, symptoms of an ulcerous tumour in the stomach presented themselves, from which he died on the 22nd instant.

Mr. Norman Tate was a native of Wells, Somerset, and came to Liverpool about thirty-five years ago, when he entered the laboratory of the late Dr. Sheridan Muspratt. He published several papers bearing on his early researches in the journals of the Chemical Society of London and the Royal Dublin Society. After acting for some years as chemist to the firm of John Hutchinson and Co., of Widnes, he commenced practice as an analyst in Liverpool, and became consulting chemist to several important local bodies and chemical manufactories. At that time the importation of petroleum from America was beginning, and on this subject Mr. Tate became an authority; one of his works, "Petroleum and its Products," being translated and re-published in France and Germany. For a time Mr. Tate superintended the working of oil refineries in the Isle of Man and in Flintshire, where he erected a manufactory for the production of coal and shale oils. In 1870, Mr. Tate, in conjunction with Mr. James Samuelson, undertook the initiation of the Liverpool Science and Art Classes, which grew to be a great educational power in the city. As honorary principal, Mr. Tate had charge of these classes, besides giving lectures himself and teaching several of the classes in chemistry, botany, and general biology. He also instituted the Liverpool Science Students' Association, and the Liverpool District Science and Art Teachers' Association, of both of which bodies he was the first president, a post he also filled in the local Geological Association, Microscopical Society, Liverpool Section of the Society of Chemical Industry, and other institutions, contributing largely to their "Transactions." The "Proceedings" of the Liverpool Geological Society also contain many of his papers and memoirs. He discovered the presence of iserine in the decomposed greenstones of the Boulder Clay in the Valley of the Mersey, and showed that the black colour of certain sandstones in the trias in the neighbourhood of Liverpool is due to the grains being coated with peroxide of manganese.

Mr. Tate was an ardent supporter of every educational movement, especially in connection with science teaching, and his death, at the early age of fifty-six, will be much deplored by a circle of friends extending far beyond the limits of the city which he had made the chief scene of his labours.

O. W. J.

THE BRITISH ASSOCIATION.

EVERYTHING is now practically ready for the meeting of the British Association, which begins next week, and promises to be in every way most successful. Many distinguished foreign men of science—among them Helmholtz, Cremona, and Sachs—are expected to be present. The arrangements made by the local committee we described last week.

In compliment to the President there will be a specially strong muster of geologists. We hear that a number of professors and others connected with the Geological Survey of France are coming. Baron von Richthofen and Prof. Credner will represent the geologists of Germany; Prof. Renard those of Belgium. There will be many other representatives from different countries in Europe and from America. The geological excursions will likewise form a prominent feature in the proceedings, and one of these is to be conducted by the President of the Association in person. The Prince of Monaco, well known for his scientific researches, intends to bring his deep-sea dredging vessel to Granton, and to read a paper on the results of his marine surveys; while two members of his scientific staff will communicate papers on some of the natural history objects obtained by them. Already a large amount of hospitality has been organized, and the meeting bids fair to be as successful in a social as in a scientific way.

We have already announced that at the meeting of Section A. on Monday, August 8, a discussion on the subject of a national physical laboratory will be opened by Prof. Oliver J. Lodge, F.R.S.

A meeting of the Electrical Standards Committee will be held on Thursday, August 4. It is expected that Dr. von Helmholtz, Dr. Lindeck of the Berlin Reichsanstalt, and others interested in electrical measurements, will be present. A discussion will take place with a view to securing an absolute uniformity in the standards adopted in England and elsewhere. The following points will be considered:—(1) The value of the B.A. unit in ohms; (2) the specific resistance of mercury in ohms; (3) standardizing by the electrolysis of silver; (4) the electromotive force of a Clark cell; (5) Report of the Committee for 1892. It is proposed to take the report of the Committee in Section A. on Tuesday, August 9. The draft prepared by the secretary is formal; but it is hoped that the discussion in the Committee may lead to some resolutions, which will be included in the report.

The proceedings of Section D. promise to be exceptionally interesting. The President's address will relate to some qualities of sensation, with special reference to colour sense. On Friday there will be a joint discussion with B. on chemical aspects of the action of Bacteria, which will probably be opened by Prof. Marshall Ward. On Monday there will be a discussion on some matters connected with sea-fishes and fisheries, in which the following will read short papers or take part:—Sir J. Gibson Maitland, Prof. M'Intosh, Prof. Ewart, Dr. Fulton, Prof. Herdman, Mr. E. Holt, Mr. R. Smith, Mr. G. Brook, &c.

NOTES.

THE summer meeting of the Institution of Mechanical Engineers, to which we referred last week, began at Portsmouth on Tuesday, under the presidency of Dr. William Anderson, F.R.S. The president, council, and members were received by the Mayor, who cordially welcomed them to Portsmouth.

THE British Medical Association's sixtieth annual meeting was opened at Nottingham on Tuesday, the chair being occupied by Dr. W. Withers Moore. In his presidential address Dr. Moore dealt with the progress which has been made in surgery and medicine since 1857, when the Association held its last meeting at Nottingham.

A GENERAL meeting of the Sanitary Inspectors' Association was held at Carpenters' Hall, London Wall, on Saturday evening last, the president, Dr. B. W. Richardson, presiding. The council presented a report upon the question of examination for sanitary inspectors, recommending that they should be empowered to confer with the court of the Carpenters' Company in order to arrange for lectures and examinations. The report was adopted. A report upon the association's recent visit to Paris was also presented, setting forth the principal features and incidents of the journey. The adoption of this report was moved by Mr. Alexander, and seconded by Mr. Tidman. The chairman, in supporting the motion, said the association had learned many important lessons upon the question of sanitation by their visit to the French capital. After comparing the French and English systems of sanitation, he expressed the opinion that in the matter of disinfection the English might learn much from their French neighbours. He believed that in London there might with advantage be established one or more grand centres for disinfection such as existed in Paris. He deprecated the system in use at the Paris Morgue of freezing dead bodies for the purpose of identification as being, in his belief, utterly useless for that purpose. On the question of the inspection of animal food, he thought that England could not do better than follow the system adopted in France of testing every doubtful animal before it went to the shambles. A discussion followed, and on the motion of the chairman an ambulance committee was formed to report on the ambulance system in London. The report was adopted.

AN official telegram received at the Hague from Batavia confirms to some extent the statement made at Sydney as to a terrible volcanic eruption in the island of Great Sangir. The volcano which caused the disaster is named Gunona Awu. The telegram adds that the whole of the north-western portion of the island was entirely destroyed, 2,000 persons being killed. The victims included no Europeans. The rest of the island has also suffered seriously by the eruption, but it is hoped that the damage may be repaired in the course of six months. The crops have been destroyed.

FOR some days the eruption of Mount Etna seemed to be gradually decreasing, but on Tuesday it was again very violent, and there were loud subterranean noises. On Monday evening there was a shock of earthquake at Mineo, thirty-seven miles to the south of the volcano. A correspondent of the *Times*, writing from Catania on July 18, says that the exact seat of the eruption cannot be discovered from that city on account of the dense masses of smoke with which that side of the mountain is enveloped, but from Augusta, a town situated about 15 miles away, the summit and western outline are to be seen standing out in bold prominence against the deep, gentian-blue of the Mediterranean sky, and, with its endless volumes of steam and smoke rolling away to the eastward, Etna presents an indescribably imposing, not to say majestic, appearance. From this little town the scene is sublime.

THE cause of the terrible disaster at St. Gervais is now being investigated by several men of science. There can be no doubt that it originated in the small glacier called the TêteRousse, which is nearly 10,000 feet above sea-level. According to a correspondent of the *Times*, who writes from Lucerne, Prof. Duparc is of opinion that the habitual drainage of this glacier had for some reason or other become either totally blocked or obstructed; the water gradually accumulated in its natural concavity or bed; and the ever-increasing volume had exercised such an enormous pressure as to force a passage and carry away a portion of the face of the glacier with it. The mass of ice and water rushed down the rocks which dominate the glacier of Bionnassay, not in a single stream but in several, and then reunited into one enormous torrent at the foot of the Bionnassay glacier. A different theory is held by Prof. Forel, of which the correspondent of the *Times* gives the following account:—Professor Forel does not see how a quantity of water sufficient to force away so large a portion of the glacier could possibly accumulate in so small a body as the Tête Rousse, which has a total superficies of less than one hundred acres. It slopes freely on three sides; it is, in fact, one of the most abrupt of the whole chain of Mont Blanc; and, in a glacier of this description, with an altitude of nearly 10,000 ft., there are none of the conditions of a great accumulation of water. In his opinion, therefore, we must look for the main cause of the disaster in the natural movement and breaking up of the glacier. He estimates the volume of ice which fell at between one and two million cubic metres. The mass, first in falling and then rushing down the rapid slope, became transformed, for the most part, into what he calls a lava of ice and water. The ravine, he says, through which this avalanche rushed shows no traces of any great evacuation of water; in the upper portions of its transit there is no mud and no accumulation of sand, but, on the other hand, there are great blocks of glacier ice strewn everywhere, and at several points he found portions of powdered ice mixed with earth. Then, again, if this had been simply a torrent of water falling, it would have found its way down the more violent inclines, instead of, as in this case, passing straight over the frontal moraine at the foot of the glacier. In this higher region, therefore, all the evidence points to an avalanche of ice, which, starting at an altitude of nearly 10,000 ft., and descending at an incline of 70 per cent. for 5,000 ft., was pulverized by its fall, a large portion of it being melted by the heat generated in its rapid passage and contact with matters relatively warm. It rushed into the ravine by the side of the glacier of Bionnassay and joined the waters of the torrent which issues therefrom, and, further aided by the stream of Bon Nant, it became sufficiently liquid to travel down the lower portions of the valley at the slighter incline of 10 per cent., and yet retained sufficient consistency to destroy everything in its passage. That this torrent was not composed merely of mud and water is proved, he says, by the fact that it did not always maintain the same height when confined to the narrower ravine, and that the remains on the sides of the rock show it to have been a viscous substance rather than fluid.

AN entire change of weather set in over these islands during the past week. The severe storm referred to in our last issue passed quickly to the south-eastward across the Channel, and subsequently traversed Switzerland and Italy. This was succeeded by an area of high barometer readings, which reached this country from off the Atlantic, and extended eastwards over a great part of Europe. Anticyclonic conditions have since been very persistent, with an unusual amount of cloud, especially in the north and south, and, occasionally, mist or fog, but the weather was otherwise fine and very dry. Temperature remained low, under the influence of northerly and easterly winds, the maxima seldom exceeding 70°, while the night minima have also been low, especially over the inland districts of England, where, in places, readings have fallen to within 10° of the freezing point.

THE Vatican Observatory, recently established by Pope Leo XIII., has issued volume ii. of its "Pubblicazioni," containing the results of the most important researches undertaken at the observatory, together with a summary of the proceedings of the meetings held in the year 1891, which comprise a collection of notices relating to astronomy and terrestrial physics. Prof. J. Buti contributes papers (1) on the variations of temperature at different heights. The maxima were generally highest at the

lower station, especially in spring and summer, while in winter the conditions were reversed. The mimima were higher throughout the year at the higher station than those near the ground. These results are in accordance with those obtained by the director, Padre Denza, in the case of observations taken at Turin. (2) On rainfall at different heights. The results show that the amount of rainfall is greater at the higher station at times of heavy rain, and conversely at times of slight rain. (3) Comparisons of relative humidity, tension of vapour, and temperature, accompanied by curves. The work also contains hourly observations from January to June, photograms of lunar regions, phototypes of some constellations and nebulæ.

As an illustration of the specialization of scientific teaching on the Continent, we may mention that Dr. H. Schinz has been appointed Professor of Systematic Botany at the University of Zürich, in order that Prof. A. Dodel may devote his course of lectures entirely to Anatomical and Physiological Botany.

GENERAL PARIS, of Dinard (Ille-et-Vilaine, France), is engaged in the preparation of a *Nomenclator Bryologicus*, on the plan of Steudel's "Nomenclator Botanicus." He will be greatly obliged if bryologists of all countries will send him copies of recent memoirs, or an exact reference to the description of all new species, accompanied, where possible, by a specimen.

A NEW botanical publication has made its appearance under the title *Arbeiten aus dem K. Botanischen Garten zu Breslau*. It is edited by Prof. Prantl and will be devoted to the record of work done in the Botanic Garden at Breslau. The first number contains a paper by Prof. Prantl, on the Classification of Ferns, one by Herr Pomrencke on the structure of the wood of certain gamopetalous families, and one by Herr Mez on the Lauraceæ.

IN addition to the Vascular Cryptogams collected under the auspices of the West India Exploration Committee by Mr. R. V. Sherring, F.L.S., in the island, and described in the *Annals of Botany*, Vol. vi., No. 21, April, 1892, by Mr. J. G. Baker, F.R.S., his collections at Kew have yielded about thirty species of Orchids from Grenada, some of which are of considerable interest. They have now been determined by Mr. R. A. Rolfe, A.L.S. The orchids of Grenada appear not to have been systematically collected before. There are no records of species from that island in Grisebach's *Flora of the British West India Islands*, 1864, and only about three or four were represented in the Kew Herbarium. Mr. Sherring's collections, therefore, enable us to arrive at a tolerably good idea of the distribution of orchids in the island. A species of *Brachionidium*, a genus not hitherto represented in the West Indian flora, is probably new, as also species of *Scaphyglottis* and *Cranichis*. *Hexisia reflexa*, *Pleurothallis pruinosa*, *Oncidium luridum* and *Ornithocephalus gladiatus* have not hitherto been found in the smaller islands, the recorded specimens being chiefly from Jamaica and Trinidad. *Dichœa hystricina* has not been found before except in Cuba by Wright and Eggers. *Xylobium* (*Maxillaria pallidiflora*) was recorded before only from St. Vincent, and *Elleanthus lepidus* is new to the West Indian flora. The remaining species are found in many islands, such as Jamaica and Dominica, but their occurrence still further south is a point of some interest.

THE City and Guilds of London Institute has issued a list of the candidates who have passed its examination for the teacher's certificate in manual training. The examination is limited to teachers in public elementary schools. It was held this year for the first time, and related to woodwork. As a large number of teachers had been receiving manual instruction before the institution of the examination, a limited number of candidates were allowed to present themselves for the final examination without having passed the first year's examination. There were 275 candidates for the first year's examination, and of these forty-seven passed in the first class, 108 in the second, and 120 failed. For the final examination there were 340 candidates, of whom forty-nine passed in the first class, 146 passed in the second class, while 145 failed. The examiners report, as regards the first year's examination, that the practical wood-working was uniformly well done, but that the drawing was badly done by a large number of candidates. "It is obvious," they add, "that the instruction in practical drawing is not good. Many candidates failed even to understand the examination paper." In the advanced examination the drawing was much better.

THE Yorkshire College, Leeds, has issued the first report of its department of Agriculture. We are glad to note that the County Lectures to farmers have, as a whole, been successful beyond the most sanguine anticipations of the committee. The unsympathetic attitude which the farmers at some of the centres assumed at first with respect to these lectures was often speedily changed to warm appreciation, which rose, in certain cases, to enthusiasm. The attendance, which was sometimes small at the beginning, grew larger and larger as the course proceeded, and although it afterwards fluctuated for various reasons, the chief of which was the unfavourable state of the weather, which in sparsely populated districts made a journey to the lecture a matter of considerable time and difficulty, the average attendance was extraordinarily good. To the classes and practical demonstrations, which followed many of the lectures, a considerable portion of the audience remained, and their eager participation in the discussions and tests, which formed a conspicuous part of the work of these classes, was extremely encouraging to the lecturers.

AT a meeting of the London Chamber of Commerce on Monday, Mr. J. Ferguson read a paper on "The Production and Consumption of Tea, Coffee, Cacao (cocoa), Cinchona, Cocoa-nuts and Oil, and Cinnamon, with reference to Tropical Agriculture in Ceylon." He referred to the position of Ceylon, its forcing climate, its command of free cheap labour, and its immunity from the hurricanes which periodically devastated Mauritius, from the cyclones of the Bay of Bengal, and from the volcanic disturbances affecting Java and the Eastern Archipelago. The plantations of Ceylon afforded, he said, the best training in the world for young men in the cultivation and preparation of tropical products, and in the management of free coloured labour. The cultivation of cane sugar, although tried at considerable outlay on several plantations forty and fifty years ago, proved a failure. More recently experiments by European planters with tobacco had not been a success, nothwithstanding that the natives grew a good deal of a coarse quality for their own use. Although cotton growing had not been successful, the island had proved a most congenial home for many useful palms, more particularly the coconut (spelt without the "a" to distinguish it and its products from cocoa—the beans of the shrub Theobroma cacao) and palmyra, as also the areca and kitul or jaggery palms. Within the past few years Ceylon had come to the front as one of the three great tea-producing countries in the world, India and China being the other two, with Java at a respectable distance. Mr. Ferguson said one of the chief objects of his pape was to demonstrate which of the products of the island it was safe to recommend for extended cultivation in new lands and which were already in danger of being over-produced, and he had arrived at the conclusion that coffee, cacao, and rubber-yielding trees were the products to plant, while tea, cinnamon, cardamoms, cinchona bark, pepper, and even palms (for their oil) did not offer encouragement to extended cultivation. Statistics relating to the total production and consumption were given in an appendix.

AN interesting paper on Indian types of beauty was read some time ago by Mr. R. W. Shufeldt, before the Philosophical Society of Washington, and has now been issued as a pamphlet. It is admirably illustrated.

MR. A. G. HOWES, British Consul at Tahiti, in his latest annual report to the Foreign Office, has the following note respecting pearl-shell diving in Tahiti:—Since the introduction of the diver's dress and apparatus at the pearl fisheries in 1890 a considerable increase in the export of shell has been maintained over the previous years. A strong feeling has, however, been exhibited by the natives, who adhere to their own system of diving, against this means of taking the shell, and has resulted in a communication being made by the Director of the Interior of the colony to the Chamber of Commerce at this place, recommending the gradual abolition of the diving dress and apparatus and the stoppage of further issue of patents for the same, from January 1, 1893. The Chamber of Commerce have expressed their approval of the suggestion, but consider that an entire and not gradual abolition of the diving dress and apparatus should take place, and they have decided to lay this proposal before the Conseil-Général when it assembles next August. The reasons set forth by the Chamber of Commerce for adopting this course are that the regulations for the use of the diving dress and apparatus have been abused. They state that French citizens, contrary to rule, have under their name employed diving dress and apparatus owned by foreigners; that the law prohibiting pearl fishing by this means in a depth of less than ten fathoms had not been adhered to, and they also give as their opinion that the shells found in a greater depth than ten fathoms are those mostly important for reproduction, and to destroy them will ruin the fisheries and bring distress upon the natives who depend upon the pearl-shell diving for their livelihood.

THE additions to the Zoological Society's Gardens during the past week include a Common Marmoset (*Hapale jacchus*) rom South-east Brazil, presented by Mr. Gerald F. Youll; an African Civet Cat (*Viverra civetta*), a white-tailed Ichneumon (*Herpestes albicauda*), two Ostriches (*Struthio camelus* ♀ ♀) from East Africa, presented by Mr. F. Pardage; a Pine Marten (*Mustela martes*), British, presented by Mr. Harold Hanauer, F.Z.S.; three North American Turkeys (*Meleagris gallo-pavo*) from North America, presented by Col. H. W. Feilden, C.M.Z.S.; two Rufous-necked Wood Doves (*Haplopelia larvata*) from South Africa, presented by Mr. W. H. Wormald; a Grand Eclectus (*Eclectus roratus*) from Moluccas, presented by Messrs. Chas. and Walter Seton; two Red-crested Cardinals (*Paroaria cucullata*) from South America, presented by Miss Edith M. Fox; a Common Chameleon (*Chamæleon vulgaris*) from North Africa, presented by Mast. S. E. Thorns; a Large Brown Flying Squirrel (*Pteromys oral*) from the Shevaroy Hills, South India, three American Bisons (*Bison americanus* ♀ ♀ ♀) from North America, a Barraband's Parrakeet (*Polytelis barrabandi*) from New South Wales, deposited; a Mongoose Lemur (*Lemur mongoz*) from Madagascar, purchased; an American Bison (*Bison americanus* ♀) from North America, received in exchange.

OUR ASTRONOMICAL COLUMN.

MADRAS OBSERVATORY.—This year being the centenary of the founding of the Madras Observatory, the officiating astronomer, Mr. C. Michie Smith, prefaces his report with a brief historical sketch. It seems that the East India Company were the first to propose the establishment of such an Observatory, but Sir Charles Oakeley, taking time by the forelock, and, as we are informed, anticipating the orders from the India Office, set about constructing it on his own authority. With the aid of Mr. William Petrie, who placed his own observatory at their disposal, the scheme was soon brought to a practical head, and by the time the orders arrived in 1792 the Observatory, besides being actually built, contained many instruments. The first astronomer was Mr. J. Goldingham. Mr. Thomas Glanville Taylor, F.R.S., was Director of the Observatory from 1830 to 1848. After erecting new instruments, he began his catalogue of 11,000 stars, publishing it in the year 1844. Hourly meteorological and magnetic observations were also carried on by him. He died in England in May 1848, having never completely recovered from a serious injury caused by a fall. In 1849 Captain W. S. Jacob was appointed astronomer; he made a new departure in the form of extra-meridional observations. Owing to ill-health Captain Jacob resigned his appointment in 1859, and during the next two years the office was held partly by Major W. K. Worster, R.A., and Major (now General) J. F. Tennant, R.E. About this time the work of the observatory was delayed, as more modern instruments were being erected, and it was not till May 1862 that the new transit circle of 5 inches aperture and 42-inch circle was ready for use. The late Mr. N. R. Pogson, who had then arrived in Madras as Government Astronomer, commenced his catalogue of 5,000 stars, observing each at least 5 times. He also used very considerably the 8-inch equatorial. The present astronomer, Mr. C. Michie Smith, in his report, suggests a further increase of the observatory equipment.

OXFORD UNIVERSITY OBSERVATORY.—During last month the seventeenth annual report of the Savilian Professor of Astronomy was presented to the Board of Visitors of the University Observatory. This report showed that the work of the Observatory during the past year has been very considerable. The Grubb equatorial, the transit circle, and the De la Rue equatorial have been severally occupied, while the new micrometer for the Grubb instrument has worked efficiently, and forms a valuable addition to the resources of the Observatory. The work upon the international chart has formed one of the important features throughout the year, and for the measurement of the photographic plates a new and costly form of micrometer had to be devised; the réseaux have not proved to be very enduring, so that in consequence a new one had to be obtained from Messrs. Gautier of Paris. The work connected with stellar parallax has now been completed after a period of four years' hard work, and this fact deserves the highest consideration in face of the magnitude of the staff and the amount of work done. The manuscript consists of (1) the concise but complete history of all effective researches in stellar parallax up to the present date; (2) the results of the parallax work completed in this Observatory, extending on the whole to some thirty stars; (3) a catalogue of all parallactic determinations effected by other astronomers. Among some of the other work commenced or completed during the present year we may mention the photometric catalogues of stars of the ninth and eleventh magnitudes within small specified areas for the eighteen Observatories engaged in the international chart, observations of Nova Aurigæ, and the investigation of the amount of light "lost by the moon at the commencement and termination of the lunar total eclipse on November 15, 1891." The finances of the Observatory at present, owing to previous economy, seem to cover the expenditure, but Prof. Pritchard seems to refer to the fact that the quinquennial grant expires at the end of the present year, as if next year the University will be called upon to make a slight additional increase to counterbalance the cost of the instrumental equipment that has been required for the chart work. We are glad to note that at this meeting of the Board Prof. Pritchard was able to attend, having completely recovered from his illness.

GEOGRAPHICAL NOTES.

M. DYBOWSKI has returned to France in bad health. His last work in the French Congo territory was an expedition up the Ubangi to avenge the murder of M. Crampel.

THE Royal Belgian Society of Geography has of late been devoting special attention to home affairs, and in particular to the publication of more or less exhaustive monographs of the local geography of the communes. The last number of their *Bulletin* contains an able summary of the geography of the commune of Familleureux, under the main heads of physical, economic, administrative geography and history, with carefully planned subdivisions. By multiplying such studies, the material for a really exhaustive geography of the country will be obtained. Some such scheme might well be applied to the United Kingdom, where a series of county geographies on a definite system and rigorously edited would be peculiarly

advantageous. The idea was present in Sir John Sinclair's famous "Statistical Account," but has had no recent or adequate embodiment.

THE *Scottish Geographical Magazine* for July contains a translation by Mr. C. E. D. Black of M. Dauvergne's recent journey in the Pamirs, the original paper appearing simultaneously in the *Bulletin* of the Paris Geographical Society. The journey carried out in 1889-90 was a most successful one and opened up some new ground. The geographical results are summed up in four sentences:—(1) That there is another great chain running parallel to the Kuen Lun and facing Kashgaria. (2) That the river in the Tung valley is an affluent of the Zarafshan, not of the Taghdumbash. (3) That the Oxus rises in the great glaciers of the Hindu Kush at 37° 10′ N. and 75° E. (4) That the Karambar valley, although difficult, is practicable for ponies.

DR. THEODOR MENKE, one of the best known of German historical geographers, died in Gotha in May last. His work in the compilation of atlases of historical geography was exceptionally thorough. His first work in this direction was a popular school atlas of classical geography, entitled "Orbis Antiqui Descriptio"; but his most important contribution to cartography was his edition of Spruner's great historical atlas, begun in 1858 and completed in 1879.

DR. STUHLMANN, according to a telegraphic report in the *Times*, has furnished additional particulars of Emin Pasha's expedition, although no more recent news. The real and only aim of Emin's journey to the Equatorial province, was to rescue those of his former subordinates, whose vacillation and delays kept them from joining Stanley's march to the coast. It was then his purpose to make his way across Africa to Adamawa and the Cameroons, a purpose which, as we already know, he had to abandon. It is satisfactory to learn that Dr. Stuhlmann had with him at Bukoba all the valuable scientific records and collections of the expedition.

THE current number of *Petermann's Mitteilungen* calls attention to a curious literary fraud to which in the two previous numbers it fell a victim, and from which many geographical journals in the habit of faithfully reproducing the articles of *Petermann* also suffer. A Dr. Ceyp professed to have made a journey recently in south-eastern Persia, and communicated to *Petermann* a detailed account of it, which now appears to have been copied verbatim from a little-known work, "Gasteiger-Khans," reprinted from the "Boten für Tirol und Vorarlberg," 1881. General Houtum Schindler, of Teheran, who knew that Ceyp's Persian travels had not led him beyond that city, gave the information which led to this discovery. The episode furnishes a fresh proof of the necessity for the great caution in accepting the records of unknown travellers which has always been exercised by the leading English authorities.

THE BEARING OF PATHOLOGY UPON THE DOCTRINE OF THE TRANSMISSION OF ACQUIRED CHARACTERS.

FOR more than two years the English public has been in possession of an excellent translation of sundry of Weissmann's more important essays.[1] The object of this paper is not to expound Weissmann's views generally. That office has already been undertaken by the persons best qualified to perform it.[2] We propose merely to discuss one of his topics under a single aspect—the "Transmission of Acquired Characters" in its relations to pathology.

We cannot, however, avoid reviewing some of the leading points in Weissmann's system which bear upon our immediate topic.

At the root of the matter lies the all-important distinction between reproductive and somatic cells. Saving among the lowest forms of animal life, an organism may be regarded as made up of two parts. There are the reproductive cells. With these the future of the species lies. They are the visible basis of its perpetuity. The remaining tissues of the body are styled "somatic." It is natural to us to think of the "somatic" tissues as something higher and nobler than the reproductive cells—to contrast the simplicity of the latter in structure and endowment with the intricacy of the former. But there is another point of view, which inverts matters; which regards the somatic tissues—the body and its manifold endowments—simply as a sort of living case or appendage of the reproductive cells. The reproductive cells look after the perpetuity of the species, the somatic cells look after the reproductive cells.

[1] Translation edited by E. B. Poulton, Schönland, and Shipley.

[2] Prof. Moseley's two articles in NATURE, vols. xxxiii. and xxxiv. Discussion introduced by Prof. Lankester at the meeting of the British Association, 1887.

Now, if we travel back to the simplest forms of animal life, we lose sight of this distinction. The principle of differentiation of labour is not yet recognized. Among the Protozoa the distinction between reproductive and somatic cells has no place. Every part of the organism has it in its power to reproduce the entire organism. No special material is reserved to serve the purposes of reproduction. As we ascend in the scale of animal life, differentiation of labour begins. There is from the outset a reservation of reproductive cells, which serve as the demonstrable links between successive generations of organisms. But in sundry of the highest forms of animal life a third condition obtains. There is at the outset no reservation of cells: differentiation overtakes the entire organism—there is no exemption.

Not till the close of embryonic life do the reproductive cells appear, and when they do so it is as the offspring of somatic cells. This third condition was felt by Weismann as a difficulty, and led to an important modification in his terminology. The problem he had to explain was this, How can cells which have apparently lost their reproductive characters afterwards regain them? The solution he found was that the differentiation undergone by certain cells was never in reality thoroughgoing enough to deprive them of their original characters. Sooner or later, a moment arrives at which the original "germ-plasm" becomes again predominant. Instead, then, of in "germ-cells," the basis of perpetuity of the species is laid in "germ-plasm."[1]

We have now to consider the bearing of these views upon the doctrine of the transmission of acquired characters.

It is of the utmost importance to understand precisely what Weismann means by the term "acquired character." Acquired characters are opposed to original characters. To grasp the distinction we are sent back to a time before the distinction between reproductive and somatic cells existed. The characters already present at this early period are original characters. Later on, the reproductive and somatic cells part company, to follow separate careers of their own. It is the somatic cells—the body—which comes chiefly into collision with the environment, and in doing so undergoes various modifications. Now these modifications are the "acquired characters" the transmissibility of which Weismann denies.

They may be something purely local, as a scar or a mutilation. They may be something which involves the modification of complex musculo-nervous mechanisms, as in delicate manipulations and tricks of skill, such as violin-playing. Now, how is it conceivable, he argues, that such specific changes in the somatic tissues should influence the reproductive cells in the same direction? Whether they influence them at all is not the matter in dispute. That they do this is not only conceivable, but highly probable. But how can the somatic cells stamp their own special characters upon the reproductive cells?

We now turn to the main topic of this paper. Has pathology anything to say, either for or against, the transmissibility of acquired characters?

Now, as to the transmissibility of sundry forms of disease there is no question. That pathological characters are transmitted is universally allowed. The difficulty, however, is to decide whether such characters were really acquired, in the strict sense in which Weismann uses the term. We shall find that it will require considerable care to adduce instances which are really appropriate. With this preliminary caution we may proceed to attempt some sort of preliminary classification of our pathological data. We shall find that they fall, roughly, into three main groups:—

(1) Morbid characters which are obviously acquired by the organism, and as obviously transmitted. But since they are in no sense the acquisition of the somatic cells as such, but of the entire organism—somatic and reproductive cells alike—they cannot be allowed to "rank."

(2) Morbid characters in which an element of transmission is obvious, but where a closer investigation reveals the fact that, supposing them to have been acquired, in Weismann's sense of

[1] See Weismann's essay on "Foundation of a Theory of Heredity," *passim*.

the word, it is not precisely what was acquired that is transmitted, but something broader and more general.

(3) The cases which are really in point: morbid characters which were really acquired by the somatic tissues alone. We shall see, later, whether or no these are transmitted.

(1) This group embraces all those cases in which a morbid character is acquired by the entire organism, somatic and reproductive cells alike. Behind the distinction between somatic and reproductive cells lies the fact of a common relation to the circulatory and nervous systems. Any change, therefore, in the circulation for example, will affect both. A pregnant woman takes a fever, and transmits it there and then to her offspring. There is no more mystery in this than in the fact that certain poisons produce abortion—indeed, the *materies morbi* is a poison in either case. But this explanation has, in all probability, a much wider range than the zymotic diseases. Consider, for example, gout. In a sense it is no doubt true to say that gout was an acquired disease. We can point to periods in the world's history in which gout was conspicuous by its absence. We can trace with some degree of accuracy its rise and progress at different epochs, and point to the conditions under which it rose, as, for example, in the early days of the Roman Empire.[1]

But even if we allow that gout was, in a general sense, an acquisition of civilized society, we have only to reflect on its pathology to see that it could never have been acquired in Weismann's sense. For what is gout? People usually think of gout by one of its manifestations—inflammation. This, however, is in reality no more than a symptom—perhaps than an incident—of a condition. The gouty attack is due to the existence of certain sites in the system conveniently cool and dry for the deposition of what are popularly known as chalk stones, if, indeed, it be correct to think of the morbid process as a deposition. The general morbid condition lies deeper, and still eludes us. But if we are in the dark as to the precise nature of the pathology of gout, it would be affectation to say that we are unable to prescribe its general outlines. Is it a degeneration, in which the entire organism shares? Then it will be a morbid acquisition of both somatic and reproductive cells alike. Or is it a failure in metabolism generally? The same will be the case. Or is it due to a failure in some particular gland to elaborate the materials brought to it, or to do its share of excretion? If so, the mischief will immediately make itself felt in the circulation, and the conditions of the sufferer will become practically those of slow self-poisoning. So that on no hypothesis can we represent gout as an acquisition of the somatic cells exclusively.

It is the element of progressive heredity which makes the hypothesis of transmission of acquired characters an attractive one in a disease like gout. This element is, in the case of certain families, strongly marked. We even see children suffering from the disease. And bearing in mind what we know of its ætiology, we naturally say to ourselves, "It was not this child's fault that he was born gouty. 'The fathers must have eaten the sour grapes,' or in this case, perhaps, have drunk the sweet ones." But it needs but a moment's reflection to convince us that the element of progressive heredity, so far from being an anomaly, is deducible from the facts of the case. It is true that here we cannot directly apply the theory of natural selection. We are not now concerned with conditions of progress, but with those of regress. Nature selects the fittest. There is no reason why she should select the goutiest. The question we have to ask in disease is not whether Nature selects, but whether she summarily rejects. If she stepped in and exterminated the gouty, she would stop gout altogether, and with it the feature of progressive heredity. But there is no reason to suppose that, as a fact, she does anything of the kind. In the first place, gout is not a disease which seriously shortens life; in an advanced stage of civilization its existence is quite consistent, not merely with life, but with the active discharge of elaborate duties.

But there is another more important consideration. Strange as it may sound, there may be good reasons for supposing that Nature, so far from rejecting, might even select, the goutiest. For gout, like other diseases, is only one corner of a much wider question. Diseases have coincidents and relations which stretch beyond the bounds of pathology, and trespass upon biology. This, indeed, is a side of clinical study which has only comparatively recently received its proper recognition. In former days men contented themselves with observing the morbid symptoms of a gouty patient; they paid no regard to his other "points"—his nails, his teeth, his intellectual endowments. But it may often happen that morbid characters have their good affinities. This is probably the case in gout. We have heard it said, for example, by one of wide experience in this disease, "No gouty person is a fool"—a statement which derives some support from the number of eminent men who have been the subjects of this disease. It is often implied that in what is termed an "artificial" civilization natural selection ceases. Might we not, perhaps, say that it still proceeds, only upon a modified plan. The conditions of the competition for existence have altered. The fittest in one generation need not be the fittest of another. Thus, in a rude state of society, in which sustained physical strength is the one thing needful, the gouty man would have no chance. His enemies, however inferior they might be, would have nothing to do but to lay by for the next attack of gout, when they would easily kill him. In a more advanced state of society all this is changed. If the gouty man has talents, he probably has friends and money. There is no demand for sustained physical strength. If he has the gout he can be nursed. His gout may be even of advantage to him—he gets into the papers. So that, paradoxical as it may seem, Nature may even select the gouty, not for their gout, but for their biological equivalents.

We have shown then that Nature, so far from interfering to exterminate the gouty, might even select them. But a more plain and obvious reason exists for the progressiveness which we sometimes observe in gout. If gout be a modification of the system generally, if its progressive increase in the tissues of a gouty patient with increasing years is in some cases a matter of observation, it would only be reasonable to infer that the same is true of the reproductive cells. For, if they share in the degeneracy, why should they not share in the progressive tendency? In the light of this consideration we can explain a fact widely received among medical men—that the incidence of a gouty inheritance falls mainly upon the younger children. Since the reproductive cells as well as the somatic grow goutier and goutier as age advances, the later their separation occurs the more likely will they be to manifest gout.

(2) The second group includes cases in which there is an undoubted transmission of morbid characters, but where it is by no means certain that they were "acquired" in the sense under discussion. But even if they were, it does not seem that what was acquired is transmitted, but something broader, and more general. We shall take as examples two important diseases—phthisis and "new growths"—alluding briefly to the phenomena of "short sight."

Phthisis may be said to be in one sense, like gout, a disease acquired by civilized humanity. "The naked savage," writes Dr. Andrew in 1884,[2] "whatever ills he may have to bear, rarely reckons phthisis among them; with every addition to his clothing and the comfort of his tree or cave, proclivity to it increases,"—a statement which is fully borne out by what we know of the spread of phthisis in the Rocky Mountains and the islands of the Pacific. If we know less of the history of the rise and spread of phthisis than we do of gout, we have more definite conceptions regarding its pathology. At the present day that pathology may be said to have two sides. There is the side originated and elaborated by Koch—the demonstration of the constant presence of a vegetable parasite in the tissues in this disease. There is the chemico-physiological side. Before Pasteur's time, such terms as "medium," "soil," as applied to the human organism, were little more than metaphors, while such words as "constitution," "predisposition," had little more than a metaphysical value. At present, scores of workers are busily engaged in translating these terms from the language of metaphysics into their chemical and biological equivalents.

If, then, phthisis was originally acquired, what was it that was acquired? It would seem that we can take our choice between saying that the microbe was acquired, or a habit of body favouring its growth. Supposing, then, the acquisition to have been no more than the lodgment of a parasite in the tissues, can we suppose that it is the parasite which is transmitted? Our facts will hardly warrant such an assumption. How, for example, could we interpret such familiar incidents as the following? A mother, after giving birth to several children, who successively fall victims to phthisis in young adult life, is ultimately attacked herself by the same disease, at a date removed by an interval of

[1] Pliny, "Hist. Nat.," lib. xxvi. cap. lxiv., ed. Franzius. Senecæ Opera, F. Haase (Lips., 1886), Epistul. Mor., lib. xv., Ep. 3 (95). Galen, "Comment. in Hipp. Aphorism," cap. xxviii., ed. Kühn, xviii. A. 42.

[2] *Brit. Med. Journ.*, 1884, 707

several years from the birth of the last phthisical child. Here we should be driven to assume, not in the case of the mother alone, but in each of the several children, a long latent period, during which the parasites, though present in the tissues, made no sign. Such an assumption presents great difficulties. Again, the direct transmission of tuberculosis from a mother to her fœtus is admittedly rare, whereas on the supposed hypothesis we should expect to find it common.[1]

But if it is not the parasite that is transmitted, what *is* transmitted? We are driven back on the "other side" of the pathology of phthisis. But if we suppose that the transmission is not one of a parasite, but of a "diathesis," or "predisposition," then we desert the only standpoint from which there is any chance of proving that the disease was acquired in the sense under discussion. For what reasonable ground could we have for restricting this "predisposition" to the somatic cells alone, to the exclusion of the reproductive cells?

On the hypothesis that the thing transmitted is a "predisposition," we can, as in gout, explain the element of progressive heredity in phthisis. For, the admission of a morbid change once made, the difficulty is not so much to explain its progression as its arrest. In certain consumptive families we have in the limits of a single generation this morbid progress going on under our very eyes. It is the rule to find in such families, where several brothers and sisters are attacked, the younger fall victims at an earlier age than the elder, showing in this way their increasing liability. The explanation is probably identical with the one suggested in gout. The entire organism of the parent becomes more and more phthisically disposed—somatic and reproductive cells alike. The later the separation of the latter occurs, the more likely will they be to manifest phthisis.

The same line of argument is applicable to the facts of "short sight."[2] Short-sightedness is certainly hereditary—it runs in families—but that does not prove that we have in it an example of the transmission of acquired characters. For in the first place it would be very difficult to prove that the short sight was in the first instance acquired in the sense under discussion. While the progressiveness of the morbid character—which seems to support the theory—can be as well explained without it. For if there is no proof that the morbid character—the faulty build of the eye—is itself progressive, there is good reason to suppose that the habits of close attention which minister to the defect are so. In one generation we find a man simply tasking his eyes; his son works with a simple microscope; his grandson with an improved microscope.

I pass on to consider another group of pathological facts, of the highest importance and interest—new growths. The element of heredity doubtless obtains here as in the case of gout and phthisis. Thus the statistics of Sir J. Paget in this island, and those of Velpeau on the Continent, agree in showing that heredity can be traced in about one-third of the entire cases of cancer.[3] And among the benign tumours, as they are called, warts and exostoses are hereditary. Further, there is in some cases evidence of progressive heredity, the irregularity appearing in the children at an earlier age than it appeared previously in the parent. And we have here what might look at first sight more like a real transmission of acquired characters than anything we have yet dealt with. No one questions that something is transmitted. The theory of the local origin of the new growths is gaining ground everywhere, and might appear to carry the inference that they are acquired, and that no constitutional element is involved in them. Here, however, we must be on our guard against the fallaciousness of words. If by constitutional we mean something pervading the entire organism—a taint in the blood, and so forth—then there is little or no evidence to warrant our calling new growths constitutional. But if we mean, on the other hand, something which was represented in the original germ—an error in the original plan, not a supervening flaw—then there is nothing to encourage us in denying, and a good deal to warrant our asserting, their constitutional origin. However, such an admission is not necessary to our present purpose. Let us assume that they are acquired in the sense in which a scar is acquired. Is it a fact that what is acquired is transmitted? If so, we should look for identity in position and histological character in the thing transmitted. But on the whole neither of these conditions is fulfilled. Certainly they are not, in the case of cancer, as the analysis by Mr. Morrant Baker[1] of 103 of Sir J. Paget's cases clearly shows. The distribution of the cancers proper shows a variation within certain limits. There is a strong predilection for certain sites, but these sites are sufficiently numerous. Now, it often happens that, where several children inherit cancer from a parent, the growth appears in each case in a different site. Nor are the precise histological characters of the growth at all faithfully preserved in the course of transmission; while it has been often observed that on the bodies of cancerous people innocent growths exist as well.[2] So that the inheritance does not appear to be a liability to a peculiar modification in a certain part, but a tendency to one or more of a group of modifications in one of many possible sites.

Once more we find ourselves driven to a choice between two alternatives, either of which excludes the transmission of acquired characters. For if new growths are really acquired characters, then it is not exactly what is acquired that is transmitted, but something broader than it. If, on the other hand, they are only acquired in a more general sense, they fall outside the limits of Weismann's sense of the term "acquired character."

(3) There remain for our consideration the third, and, in one sense, the most important, group of pathological data—those which answer to the qualifications of acquired characters in Weismann's stricter usage of the term. Here, if anywhere, would be the ground in pathology to select for proving the theory of the transmission of acquired characters; but it must be confessed that this is just the region in which that theory receives the least support. This group of pathological facts embraces a number of accidental lesions, such as scars and mutilations, which are certainly acquired in the strictest sense of the word. But the evidence for the theory seems strong only in the dubious cases, weak in the unexceptionable ones. We have examples of mutilations practised for many centuries by entire races, without being transmitted in a single instance. Nor is it the experience of surgeons that scars and mutilations which are the results of operations are ever transmitted. On the other hand, we have histories of tailless cats and hornless cows. But here everything turns upon the comparative certainty with which we can prove that the initial lesion was really in the first instance acquired. Have we here to do with an accidental lesion or a deformity? A closer investigation has, in many instances, rendered the latter the more probable explanation of the two. For example, in the case of the tailless cats, closer research made it appear that the irregularity involved an abnormality affecting many of the lower vertebræ. In other cases, the abnormality in the child was so little like that in the parent, as to suggest that it was a merely accidental coincidence of two different lesions in one site.[3]

If we turn to the results of experimental research, we are confronted by more than one remarkable series of experiments, upon the bearing of which it is impossible as yet to pronounce decisively. The most notable work done in this direction is, perhaps, a series of experiments upon guinea-pigs, undertaken by Brown-Séquard, and repeated by Westphal.[4] They produced epilepsy in a number of these animals by various methods—section of the cord, section of different nerves, &c.—and observed subsequently that certain of the offspring were epileptic too.

But there are several reasons which prevent our accepting these results as decisive. The records of the experiments are said not to be very perfect. Then it is not contended that epilepsy was uniformly transmitted. What happened was that each member of the offspring presented some morbid symptom—usually some nervous trait, such as epilepsy or paralysis. So that the result of Brown-Séquard's experiments would rather seem to be this. By producing one morbid trait in the parents, he set up a liability to one of several in the offspring. By producing a single character, he set up a tendency. All this is of extreme importance, and it may well be that the future has much that is interesting to reveal in this direction. But, meanwhile,

[1] See *Fortschritte der Medicin*, Bd. iii., 1885, p. 198; bacilli found in lungs of fœtal calf, æt. 8 months, whose mother was tuberculous.
[2] Ziegler and Nauwerck, "Path.," vol. i. pp. 393-94.
[3] Erichsen, "Surgery," seventh edition, p. 787.

[1] See "St. Bartholomew's Hospital Reports," 1866.
[2] Observation of Mr. J. Hutchinson, quoted in Fagge's "Medicine," vol. i. p. 106.
[3] For a number of other instances, see Weismann's essay on "The Supposed Transmission of Mutilations," *passim*.
[4] See Brown-Séquard, "Researches on Epilepsy," Boston, 1857: Papers in *Journal de Physiologie de l'Homme*, tom. i. and iii., 1858, 1860; *Archives de physiologie normale et pathologique*, tom. i.-iv., 1868-1872. Ziegler and Nauwerck, vol. i. p. 390. See also Weismann on Brown-Séquard, pp. 81, 310, 313; translation, edited by Poulton.

it cannot be said to lend very much direct support to the theory now under discussion.[1]

Again, the choice of lesion in these experiments was a somewhat unhappy one. Epilepsy is a symptom which can be produced in a number of ways—its proximate cause, if there be a single one, we are not as yet in a position to formulate. Attempts in this direction usually go no further than a vigorous and often highly poetical description, in which metaphors drawn from the phenomena of electricity are liberally employed. It might have been more advantageous to have aimed at the production of less equivocal symptoms, whose pathology is less disputed—such, for example, as facial palsy.

Lastly, we cannot exclude from these experiments the possibility of the introduction into the system of chemical poisons or even parasites, as incidental results of the operations.

But this does not by any means exhaust our stock of instances. The pages of pathology furnish us with more than one group of important facts which satisfy all the conditions of acquired characters.

Chief among these stand those numerous modifications of various organs which we regard, and rightly regard, from a clinical point of view, as part of a given disease, but which might perhaps be more correctly described as secondary adjustments made by the organism to meet certain primary morbid changes induced in different organs by the disease itself. Such, for example, is hypertrophy of the heart consequent upon valvular disease. Such hypertrophy is or is not a morbid symptom according to the point of view we happen to take. From the clinical standpoint it may be conveniently treated as part of the disease. From the biological standpoint it is an effort on the part of the organism to adjust itself to altered conditions brought about by the disease. It is certainly an acquired character, in the strict sense of the term.

An illustration will make this plain. Rheumatic fever is an hereditary disease.[2] Inflammation of the valves of the heart is common in rheumatic fever, and hypertrophy of that organ often follows as a consequent of this. But who would reckon hypertrophy of the heart as forming part of a rheumatic inheritance? It is true, no doubt, that whoso is heir to a disease is heir by implication to all the biological incidents of that disease. But he is not heir to them for the same reason. The one belongs to him as the inheritor of a morbid tendency, the other as the possessor of an organism. Diabetes, again, is in some cases markedly hereditary. Secondary characters are acquired in the course of this disease also; such as hypertrophy of the bladder or stomach. But, however doomed from his cradle to diabetes a peason may be, he is not born with an hypertrophied bladder and stomach. We should think it absurd that such accommodations as these should be made before they were wanted. If, then, we are right in regarding these as really acquired characters—and it is difficult to see how we can avoid so doing—it seems that pathology has here afforded us a sort of crucial experiment. Of the morbid characters of which sundry diseases are constituted, some are inherited, some are acquired—the one are constantly transmitted, the others, so far as we know, never are.

But no one pretends that every disease is inherited. Consider, for example, such a disease as lead-poisoning. Here, there is not, obviously, any element of heredity. That two people are not equally liable may be true enough; that predisposing causes exist is doubtless the case; but that does not prove an element of heredity. Predispositions may be themselves acquired, as is the case in alcoholism. In such diseases as lead-poisoning, we rightly stress the importance of the environment, and minimize inherited tendencies. But such diseases will be of little use to us here, unless two conditions are complied with. The first is that they leave durable and definite lesions behind them; the second is that such lesions are not inconsistent with the procreation of children. Of such lesions the familiar "wrist drop" of lead-poisoning may be cited as a good example. It is often durable; in not a few cases it is not cured; it is not inconsistent with the procreation of children. But there is no evidence to show that this or kindred lesions are ever transmitted. Facial palsy would be another instance, this malady being often of considerable duration. This group of cases constitutes another piece of negative evidence, not so important as the last, because these cases are rarer, but still not unimportant.

It can hardly be disputed that these characters are acquired in the sense under discussion. There must have been frequent opportunities of transmission, but we have no evidence of anything of the kind.

The general conclusion we have arrived at in this paper is that pathology, so far from offering any support to the hypothesis of the transmission of acquired characters, pronounces against it. We have seen that it is possible to bring up a mass of evidence, which seems at first sight to favour that hypothesis. On further consideration, however, it becomes clear that only a small portion of that evidence can be allowed to "rank."

A considerable number of facts must be rejected, because though there can be no doubt that the morbid characters here present are both acquired and transmitted, they are not acquired in the sense under discussion—that is, by the somatic cells exclusively—but by the entire organism.

A considerable number of facts, again, meet with a like rejection, because there is no question that here certain morbid characters are transmitted, yet even supposing them to have been acquired, it does not appear that precisely what was acquired is transmitted, but something broader and more general.

A considerable number of facts remain, which may be allowed to "rank" as genuine instances of acquired characters. These, if the hypothesis be correct, should be transmitted. But of such transmission we find little or no trace.

If we begin with scars and mutilations, even if the facts are not all on one side, the balance of evidence is decidedly against the hypothesis. If we appeal to the results of experimental research, the question is more open; but if the hypothesis does not encounter quite so decided an opposition in this quarter, it can scarcely be said to derive much support there.

If we pass into the main region of pathology, we have to use some circumspection in looking about for instances which shall be genuine examples of acquired characters. That such instances really exist it has been our endeavour to show, notably in those secondary characters which organisms acquire by way of accommodating themselves to the effects produced by disease. So far from being rare or recondite, these constitute a group of familiar and well-ascertained facts. If transmission has not occurred, it cannot be for want of opportunity—there must have been scores of such opportunities. That it has not occurred, constitutes a piece of very important evidence against the hypothesis under discussion.

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[1] For other instances of supposed transmission of morbid characters artificially produced, see Ziegler and Nauwerck, "Pathology," vol. i. pp. 391–92; Brown-Séquard's operations on eyes, Mason's on the spleen.

[2] "Treatise on Medicine," by Fagge and Pye-Smith. Third edition, vol. ii. p. 694

A TRIP TO QUEENSLAND IN SEARCH OF CERATODUS.[1]

MY main object in going to Queensland was to procure, if possible, the eggs of Ceratodus and the creature itself; secondly, I wanted to collect earthworms; and, thirdly, to see the country. In my main object I was quite unsuccessful, for the simple reason that this year Ceratodus did not lay its eggs till late on in November—two full months later than the time recorded by the only observer who had up till then procured them. University work forced me to return, not by any means empty-handed, but without the one thing which had tempted me to go north.

To save time, and avoid unpleasantness also, I went by train. It is a long weary ride across New South Wales, especially in warm weather. Unfortunately I left Sydney by the northern mail on Friday evening. There were very few carriages, and some of what there were were "engaged" for legislators who travelled home free and in ease whilst we who paid for our journey were huddled and crowded together. This discreditable state of affairs seems to be common at the close of each week during the sitting of Parliament in Sydney.

The journey north leads by the side of the Hawkesbury River, and after passing across the well-known bridge the train skirts the shores of what appears to be a succession of lakes. In reality, the winding river, shut in by wooded hills, expands every now and then into sheets of water, each of which in the gathering darkness seemed to be a little lake. About eleven o'clock you find yourself apparently running along through the streets of Newcastle, and stretching out eastwards see the long quays and

[1] Paper read by Prof. W. Baldwin Spencer, before the Field Naturalists' Club at Victoria, on March 14. Reprinted from the *Victorian Naturalist* for June and July.

open water leading out to the sea. The whole is brilliant with numberless electric lights, though you have an idea that in daylight coal dust would be a little too prominent. As it is, however, Newcastle is associated in one's mind with a series of flashing and twinkling lights prettily reflected in the water and with a very second-rate refreshment-room. Afer Newcastle you settle yourself down as comfortably as possible for a run northwards of 400 miles, through the night and greater part of the next day, to the Queensland border. You seem to get gradually more and more out of the world until at five o'clock next afternoon the train pulls up at the border station. By that time our number of passengers has been reduced to four. After looking about, a minute train, which at first sight you take for a toy, is descried at the end of the platform. Further searching shows a very narrow gauge line streaking away through the limestone hills northwards into Queensland. The original name of this border station was Wallangarra, but unfortunately this is now being changed to Jennings. It is a pity to lose the old native names and to substitute for them such ugly ones. One would have thought that a more effective plan of perpetuating the memory of legislators might have been devised.

Small though the railway is, it is very comfortable and well managed, and all officials uniformly courteous. The carriages are like the insides of omnibuses, with a broad seat all round the windows. On express trains the last car is always for smokers, and has a little balcony on which you can sit out in the open air right at the end of the train, and hence shielded from wind and dust. This is a most excellent arrangement. From Wallangarra the train runs to Warwick, and then, across the uplands forming the Darling Downs with their wonderfully rich dark-red soil, on to Toowoomba. Here the line turns nearly due east and begins to climb gradually to the top of the Dividing Range close to the eastern escarpment of which Toowoomba lies. Suddenly you turn a corner, the upland country ends abruptly, and the train zig-zags rapidly down the face of the lofty escarpment which rises directly from the flat coastal district. The sun was setting just as we reached the crest, and in the brief twilight we had magnificent glimpses of the distant plains with the abrupt hill sides and deep gorges in the foreground. Close upon midnight Brisbane is reached.

A slight difficulty arose in Brisbane with regard to my small amount of collecting material, but on learning that it was simply intended for scientific purposes, the Customs officials at once courteously saved me all trouble by allowing it to enter free of duty. In fact my experience in Queensland was that I met with the greatest courtesy from all officials, and the greatest kindness from such friends and strangers as it was my good fortune to be brought into contact with—an experience common, I believe, to all visitors to the Northern colony.

From Brisbane the line is now continued through Maryborough on to Bundaberg at the mouth of the Burnett River.

About seventy-five miles north of Brisbane the vegetation changes almost suddenly, and the line runs across a belt of country, perhaps twenty miles wide, of a semi-tropical description. To this we will return presently; suffice it to say at present that the traveller finds himself suddenly surrounded by palms and pines and fig trees, and sees all the tree trunks covered with epiphytic ferns—with great masses especially of staghorn and bird-nest ferns, and with orchids from which hang down long clusters of yellow blossom.

This belt of vegetation stops as suddenly as it began some few miles south of Gympie—a well-known gold-mining town, which lies by the side of the Mary River, and where I had been told that Ceratodus was to be had in abundance. Here I determined to stay, and began at once to make inquiries. To my disappointment I found that no one at the hotel knew anything about the animal, but I wandered forth in quest of information. The river itself was dirty with the washings from the mines, and looked anything but promising; however, I made for some miserable huts on the outskirts occupied by Chinese, and after a little trouble found a fisherman amongst them. This individual was decidedly apathetic, but after some time said that he might or might not be able to catch me a few. Wandering along by the river I began to feel rather as if I were searching for a needle in a haystack. However, I learnt that the fish certainly were to be caught, though some few miles away, but that there was no chance whatever of getting assistance from any blacks, simply because there were not any in the neighbourhood, and at that time I thought their assistance indispensable. It was late in the afternoon and I wandered on by the river searching for planarians and earthworms. Amongst the former I secured two specimens of a beautiful new species, to which Dr. Dendy has given the name of *Geoplana regina*, and also specimens of the almost cosmopolitan form, *Bipalium kewense*, and of *Geoplana cœrulea*, a form common in New South Wales, rare in Victoria, and very abundant indeed in Queensland. This was, I believe, the first time on which land planarians had been collected in Queensland—not that there was any difficulty in finding them, but that no one had taken the trouble to look before. Amongst earthworms, I collected for the first time for myself a true perichæte—that is, one in which the little setæ, or bristles, form a complete circle round each segment of the body. In all our Victorian forms, without exception, there is a break in the mid-dorsal and ventral lines where the setæ are absent. True perichætes do not appear to come further south than the north of New South Wales. Under the logs also were specimens of a common Queensland worm, *Cryptodrilus purpureus*; of a new species of perichæte worm, *P. gympiana*; together with three species of frogs—*Pseudophryne bibronii*, *P. australis*, and *Limnodynastes tasmaniensis*.

During the evening I had the opportunity of talking to one or two who were well acquainted with the country, and was strongly advised to go on without delay to the Burnett River. I determined that this would be the wisest course to adopt, and accordingly packed up next morning, and after an hour or two's stroll round Gympie, during which I did a large amount of log-rolling with but scanty success, owing to the extreme dryness of the country, once more took train northwards towards Maryborough. I spent the night at a little wayside inn, where considerable surprise was evinced at my putting in an appearance; however, a wandering lascar turned up, so that I was more or less kept in countenance, and together we had tea in what was presumably a combination kitchen and scullery. During two or three hours' collecting I met with nothing but gum trees, endless ants and scorpions, a few stray specimens of *Geoplana cœrulea*, and one or two lizards and frogs. I somehow had the idea that north of Brisbane everything would be at least semi-tropical, and could not at first help feeling disappointed to find myself, except in the small district mentioned before, surrounded by little else but gum trees, without a trace of a palm or of anything which looked at all tropical. Eastern Gippsland was really richer in vegetation and more varied in form of animal life than the part of Queensland in which I spent most of my time. In fact, so far as my experience yet goes, Gippsland, as a general collecting ground, would be very hard to beat.

Early in the morning I started in a mixed train along a branch line leading inland for some fifty miles, till it stopped apparently nowhere in special, and not far from a fine mountainous bluff. The station is called Biggenden, and here we found coaches waiting for us. A Queensland coachdriver is a most marvellous man, both in the way in which he accepts with almost pleasure any amount of luggage, and in the way in which he stows it all on board. From Biggenden came a hot ride of about forty miles across uninteresting country. The only township we passed was a small place known as "The Shamrock," not far from the goldfield of Paradise. After changing horses we started off again, seeing nothing but gum trees and a few emus and kangaroos. Among the gums were what are locally known as blood gums, whose light-coloured trunks are covered with reddish blotches, due to the exhalation of kino; woollybutts, which for perhaps ten feet above the ground have the trunk somewhat like that of a stringybark, and above this are quite smooth and whitish; and a form of gum called brigalow. This grows in clumps, and differs from all the others in having its foliage comparatively dense, so that it affords a good deal of shade. The cattle congregate in the shade, and these dark patches give a curious and characteristic appearance to the landscape. Every now and then we came across a few birds, known as squat pigeons. These have the habit of squatting on the ground when approached, and, being of a brownish colour, are hard to see. Sometimes they can be knocked over by the whip of an experienced driver.

Late in the afternoon we mounted a slight ridge and came down through a gap into the wide Burnett Valley. On either side of this rise low hills, and through the middle flows the river with a broad channel, occupied chiefly—except during the flood season—by long, broad stretches of sand. A short ride brought us to Gayndah, a long, straggling township on the river banks, and here I took up my quarters in the comfortable

Club Hotel. At one time Gayndah was the centre of a wool-producing district, and bears evident signs of having seen a better day.

Intent on meeting with Ceratodus, I made my way to Mr. Thomas Illidge, the postmaster of Gayndah, to whom I had been recommended, and I gladly take this opportunity of expressing my thanks to him, not only for the valuable help and information which he gave me, but for many acts of kindness which added greatly to the pleasure of my stay in Gayndah. I may here also express my thanks to my friends, Dr. Cole and Messrs. Frank and Virgil Connelly, from whom—though a complete stranger—I received most valuable help. If a naturalist wishes to meet with genuine kindness and every possible assistance, I can warmly recommend Gayndah to him.

One of the first things I learnt was that Dr. Siemen, of the University of Jena, had recently come to the Burnett district for the purpose of securing the eggs of Ceratodus, and the various development stages of Platypus and Echidna; and not only this, but that he had secured the services of the available blacks. I must confess to a feeling of something like chagrin at having come so far to meet with, apparently, no chance of success in what was my main object.

After sleeping over my preliminary disappointment, I determined on carrying out the only plan possible, which was to obtain one or two boys accustomed to the river, and, with their help, to at any rate get Ceratodus, and, if possible, the eggs. It was now well on in September—the time at which Mr. Caldwell had found that the animal had laid eggs—so there was still hope that I might secure them. Perhaps it may be well here to state briefly the special interest which attaches to this particular form Ceratodus. As you all know, there are two groups of animals—the fishes and the amphibia—of which the first live in water, and breathe by means of gills, whilst the second either spend, as the newts do, their whole life in water, breathing by means of gills, or else, like the frogs, spend the early part of their life in water, breathing by gills, and then come out of the water and breathe by lungs just as reptiles and mammals do.

Now there is a very small group of animals known as the Dipnoi, which are, we may say, intermediate between the fishes and the amphibia. They are neither so lowly developed as the fishes, nor so highly developed as the amphibia—in fact, they may almost be described as "missing links" which still exist, and show us the way in which air-breathing were evolved from water-breathing animals. If we simply went by their external appearance we should class them amongst fishes, which they closely resemble in many respects. Now, fishes have what is known as a swim-bladder, which is merely a long hollow process developed from the œsophagus. This serves, probably, mainly as a float, and not at all for respiratory purposes; but in the small group, Dipnoi, of which Ceratodus is one, this same swim-bladder becomes modified to act as a lung. Not only this, but, whereas in fishes the impure blood which is carried from the body to the heart passes to the gills, is purified there and then goes straight to the body, in the Dipnoi part of the blood goes from the heart to the lung, and then is carried back again to a chamber in the heart specially developed for its reception. In fact, in the Dipnoi we can see some of the earliest stages in the evolution of important organs of the body as we now find them in all animals above fishes.

At the present time only three examples of the Dipnoi are known to exist in the world—one form, Lepidosiren, lives only in the Amazon; another, Protopterus, is only found in tropical Africa; and the third, Ceratodus, occurs only in the Burnett and Mary Rivers, in Queensland. In past times, however, Ceratodus lived in other parts, such as Europe, as its fossil remains testify; and in Australia Prof. Tate has recorded the presence of its teeth in the strata of the Lake Eyre basin. In fact, Ceratodus is one of those rare forms of which fossil remains were found and named before the living form was discovered.

The habits of Protopterus have been studied, and it is stated that during seasons of drought it makes a cocoon of mud for itself, and breathes by means of its lung. On account of this habit, these forms have often been called mud and lung fishes.

My main aim, then, was to find the eggs of the Ceratodus. From Mr. Caldwell's published notes, which are only too brief, I knew that it deposited them much like some amphibians, such as the Axolotl, do, on weeds, and that he had found them in September.

To return now to Gayndah. I purchased a tent and provisions, and having hired two boys accustomed to the river, started away to camp out some few miles up the Burnett. The country was very dry and sandy, with all the creeks empty of water. The outcropping rocks are granitic, with basalt capping the hills around, and the disintegration of the granite appears to give rise to a vast amount of sand. Along the river itself there is an alternation of large sandbanks, where the stream is shallow, and of long deep pools with great granite masses. The banks are bordered by bottle-brush trees (Callistemon), which at that time were crimson with flowers, and alive with thickheads. Leaving my stores to find their way to an appointed spot, I kept by the river bank on the look-out for weeds, for without these it was hopeless to set to work. After a short halt at a station close to Mt. Debatable, where the sociable wasp (*Polistes ferrugineus*) was busy making its nest in the verandah, I walked on until we were some six or seven miles out of Gayndah but there was not a trace of weed in the river. Close in to Gayndah, there was a small quantity, but where we expected to find a good supply there was none at all, owing apparently to heavy floods which in the last wet season had swept down the river. Accordingly we turned back and pitched our camp not far from Gayndah. It was evening by the time we were settled down, and too dark to see the eggs, so we lit a fire and fished. It was a lovely moonlight night and the coolness was delightful after the heat of the day. The river is full of fish, and we caught sand eels and mud eels, jew-fish, perch, and bream, but not a single Ceratodus—or, as they call it locally, salmon. Turtles kept rising to the surface and showing their black heads above the water, and every now and then when we sat still we could recognize a Platypus. In the morning I set to work to search over the weed. One of my boys stripped and went into the river for it, whilst I sat half in and half out of the water looking carefully over each piece. In the hot blazing sun this was not enjoyable, and after some hours' work, and not the slightest sign of an egg, and when the small patch of weed was pretty well exhausted, I sat down to think, and questioned my boys closely as to where there was more weed. A little way on the other side of Gayndah they told me there was a backwater usually full of weed. Why they had not told me of this before I could not imagine, and the remarks made probably conveyed this idea to them. However, we were close to the end of this weed, and as we had to get to some more, I sent one boy into Gayndah to procure help in removing our camp, for which, fortunately, I had made previous arrangements In the afternoon I finally exhausted the weed and myself with no result, and for a change set to work to turn over a few logs. Amongst planarians, *Geoplana cœrulea* and *variegata*; amongst earthworms, *Cryptodrilus purpureus*; amongst frogs, *Limnodynastes tasmaniensis* and *Hyperolia marmorata*; and amongst lizards, species of Pygopus, Hinulia, and Egernia, and a small mammal, a species of Antechinus, rewarded my efforts, but everything was too dry, though the season was early, for anything very much in the nature of worms. Along the river banks endless numbers of the beautiful butterfly *Danais erippus* attracted my attention. It was feeding on the plant (Lanthana) along with which it has been introduced. In the river itself was to be seen the curious water lizard *Physignathus lesueurii*, of which we caught a small specimen, and also the frog *Hyla lesueurii*, whilst the Callistemon trees contained plenty of a little green species of Hyla which the boys used as bait for fishing, and which appears to be new to science. I also caught this same frog on window panes at night in Gayndah, where, like a moth, it goes to the light. As the evening came on the mullet began to jump. They feed especially on a filamentous alga which grows in the water, and contains numerous crustaceans, especially a prawn-like form, for the sake of which they eat the alga. The latter is used as bait for them. At night we caught a large mud eel, five feet long, which we eagerly drew into land, thinking it to be a salmon. I tried sugaring the trees, but it was of no use, not even a single ant put in its appearance, and thus ended another day of hard work and disappointment.

In the morning I had my boys up by 4 a.m., and before six we were out of camp, and by nine o'clock had our tent pitched by the side of a backwater on the other side of Gayndah. This contained plenty of weed, and here I spent some days. We procured a long pole, with three prongs at the end, to pull the weed up with. We used to get a large bucketful at a time, and then go over it piece by piece. This process had to be conducted under a hot sun, and the result was that my arms became swollen to about double their natural size—so much, indeed, that I could

not sleep with anything like comfort, since the slightest pressure woke me up. The final result was that I did not see the slightest trace of any Ceratodus eggs, though, had they been there, there is no doubt but that we should have found them. I then sent one of my boys down the river for some miles to see if there were any more weeds, but there were none to be seen. Just at this juncture I heard of some blacks, but on trying to secure them found that they were anticipating a "muster" on one of the neighbouring stations, and were not to be procured. Seeing no prospect of getting what I wanted, and being none the better for my exposure to the sun, I went into Gayndah.

Here I may, perhaps, say something as to some conclusions I had come to with regard to the habits of Ceratodus. With the exception of the brief account given by Mr. Caldwell as to the laying of its eggs on weed, and the curious amphibian-like embryos, we know little about the natural history of the animal. As before said, it is confined to two Queensland rivers—the Mary and the Burnett, and my experience is limited to the latter. Firstly, with regard to the animal's name. The Dipnoi have two popular names—"lung fishes" and "mud fishes"—the latter given to them because, in the case of Protopterus, the animal may live for a part of the year in mud. The Ceratodus is not known locally by either of these names; it is, however, sometimes called the "barramundi" and sometimes the "salmon." The first of these is, however, really that of a true osseous fish (*Osteoglossum leichardtii*), which lives chiefly in the Dawson and Fitzroy Rivers, further north than the Burnett. The second is a fanciful name, given on account of the very pink-coloured flesh of the animal. Beyond this there is no resemblance whatever between the real and the so-called Burnett "salmon." Mr. Saville Kent, in his report on fishes to the Queensland Government, states that Ceratodus is a valuable food fish. This is a curious mistake. Its flesh is very oily, coarse, and disagreeable, and it is but rarely eaten, and then only by Chinese and those who can afford nothing better. There is thus, I am thankful to feel, not much fear that so interesting an animal will become rapidly exterminated.

Now, as to its method of life. Ceratodus is a big fish, and may reach the length of six feet, and even more. I believe the largest ever caught weighed eighty-seven pounds. It is always to be met with in the deep pools, and not in the shallow waters, and it is important to notice that these pools are many of them of considerable extent, some more than a mile long. In the hottest summer they contain a good supply of water, and thus, though occasionally a Ceratodus may, of course, find its way into a shallow pool which gets dried up, normally no such thing happens, and the animal passes its whole life in water. The usual idea is that the lung is of service to the animal, as in the case of Protopterus, when the waters practically dry up. I very much doubt if Ceratodus ever makes for itself a mud cocoon, as Protopterus does. It may possibly, but very rarely, bury itself in mud, but the fishermen with whom I spoke, and who were perfectly well acquainted with the animal, knew nothing of its ever doing this. On the contrary, I fancy that the lung is of at least as great service to the beast during the wet weather as during the dry season—and probably even of greater.

Normally, then, we may say that Ceratodus never leaves the water. If by any chance it gets out of the water it is perfectly helpless. You may put one close to the edge and there it lies passively. Its weak limbs are quite incapable of sustaining the weight of the body. Nor can it live out of the water, unless kept constantly damp, for more than a very few hours—not, indeed, so long as the jew-fish from the same river. In the water, however, it constantly uses its lung. Sitting by the stream when all is quiet in the evening, you can hear a diminutive kind of spouting going on, the animal at intervals rising to the surface and expiring and inspiring air much as a minute whale might do. Out of the water, too, it does not open and shut its gill flaps like an ordinary fish, but they remain tightly shut, and the animal opens and closes its mouth, to all appearances breathing like one of the higher forms.

If we consider the environment of the Ceratodus we shall see that there are two special and constantly recurring conditions under which a lung would be useful to it.

In the wet season the tributary creeks, dry in summer, become transformed into roaring torrents, and when once you have seen the great sandbanks along the river bed and the dry sandy country through which the creeks pass, you can easily recognize what a vast quantity of sand must be brought down during the course often of a very few days, and how thick the water must become with fine particles. On the other hand, during the hot season there suddenly grow with enormous rapidity great quantities of water weeds. The river is then at its lowest and the decaying vegetable matter will often render the water foul. Under either of these conditions you can see that the possession of an organ enabling the animal to remain in its natural element and yet breathe air directly will be of great advantage to it. It is the shallower pools especially which become chocked with weeds, and since normally the Ceratodus lives in the deeper pools, in which is the purer water, it is, I think, very probable that the flood season, when the water is disagreeably full of sand and mud, is the time when the lung is of greatest service.

In Gayndah I learned that Dr. Siemen was camped out some forty miles up country, where the Auburn and Bowen Rivers join the Burnett, close to one another. Accordingly I made up my mind to go up the river, both to see him and to search for weed. The difficulty was how to get there. However, I met with a friend in the person of Mr. Bailey, proprietor of the Queensland Hotel, who, at considerable inconvenience to himself, promised to see me through the difficulty; and, taking one of my boys with me, we left Gayndah early one morning, before 4 a.m.

The country was extremely dry and sandy, with poor gum trees, and every now and then a patch of brigalow. By 10.30 we reached a wayside accommodation house, and then in the heat of the day we started off along a most miserable track across country as utterly uninteresting and monotonous as can well be imagined. We had two good dogs with us, and the only break in the monotony was when they put up a big "iguana." Most were much too quick for them, but one they got hold of, and it was wonderful to see how they stuck to him without getting within reach of his mouth. When all was over I slung him over a dead trunk, to get his head on the way back. However, when we came back he was not perfectly fresh, and was left behind. By 4 o'clock we had crossed the Bowen River and pitched our camp about a mile beyond. Then I walked on to Dr. Siemen's camp. My advent was announced by the yelping of sundry mongrels, the property of a small camp of blacks. On these animals I kept a sharp look-out. Dr. Siemen I found living in comparative luxury, and from him I received a most cordial welcome. We spent the evening most pleasantly talking over matters of common scientific interest. Three of his blacks came in with a few Echidnas. I learnt from him that he had been no more successful than myself in procuring Ceratodus eggs—that, in fact, they had not begun to spawn yet. Unlike myself, however, he was able to stay there until they did spawn, and most generously offered to procure certain material for me. There was a small amount of weed in the river but not a trace of an egg. On cutting open the body of a "salmon" I found the spawn inside, looking very similar, indeed, to that of a frog, each separate egg being black in colour at one pole. It was evidently not yet quite ripe for laying. The season when Mr. Caldwell got his eggs in September seems to have been an exceptional one as regards the temperature and amount of weed in the river. There had been no big flood for some time previously to his visit, so that the river was full of weed and everything was favourable for the depositing of spawn. This season, as luck would have it, the warm weather started rather late and the weeds had been largely washed away by heavy floods, the river at the end of September being comparatively high. I think it safe to say that, granted the presence of eggs, they could be got by "whites" just as well as by "blacks." Any collector going at the right time and not frightened of tiring and tedious work could get them for himself now that the manner of spawning has once been ascertained. Each egg, surrounded by a little gelatinous capsule, is laid on weed, but I think, from what I heard with regard to Mr. Caldwell's methods, that he found it necessary to spend a very considerable time in the neighbourhood of the river whilst the embryos were slowly developing, as they were not easily and safely carried about. The next day Dr. Siemen and I spent together with, I trust, mutual enjoyment—at all events, to myself it was one of the pleasantest days I spent in Queensland. I did a small amount of collecting, but it was far too dry and sandy to get anything in the way of worms. Down by the river I came across a black woman and pickaninny fishing, but they were frightened when I spoke to them, and fled. There were large numbers of *Danais erippus*, and of a beautiful species of Acræa with transparent wings. Late in the afternoon I at-

tempted, but with not very great success, to photograph some blacks. One especially, named Frank, had his back scored with cicatrices in regular pattern. I spent the evening till 11 o'clock with Dr. Siemen, and said good-bye to him, wishing sincerely that he might be successful in his endeavours to secure what we were both in search of, and what it was perfectly evident that I myself could not obtain.

I may here say that Dr. Siemen had with him the best of the blacks who were with Mr. Caldwell, and who secured for the latter the eggs of Ceratodus. These blacks were fine and powerfully-built fellows; but here, as everywhere else, rum and disease are rapidly lessening their numbers.

On the way back our dogs started many big lizards, and it was amusing to see one of them hanging on to the tail of a large *Cyclodus gigas*, whose head and body were hidden in the hollow of a log. Few lizards we met, as well as species of Hinulia and Liolepisma. We camped by the Burnett, some twenty miles out of Gayndah, and spent the evening fishing in a little backwater. There are two kinds of turtle in the river, the long-necked (*Chelodina longicollis*) and the short-necked (*Chelymis macquariensis*), and sometimes one is surprised at pulling out a turtle instead of a fish. Next day we made our way back into Gayndah, passing by large patches of grass trees in full flower, with swarms of the little black native bees hovering around them. Just as we were passing through a mob of travelling cattle our dogs started two kangaroo rats (*Bettongia*, sp.). There was a general scattering as the little animals, with the dogs in full chase, ran through the mob. After a short run one was caught, which had in its pouch a single small young one not more than $1\frac{1}{2}$ inch long.

I stayed a few days in Gayndah, hoping to make a collection of earthworms, which up till then there had been very little chance of collecting. The name of the township will be well known to Australian etymologists, since it was here that Mr. Masters made a very fine collection; he was fortunate enough to have almost a year in the district, and thus secured forms at all seasons. About a mile behind the township is a large stretch of scrub, where I spent a considerable time, often accompanied by one or other of my friends—Messrs. Illidge, Cole, and Connelly—to whom I am indebted for help in the laborious task of digging out worms from dry ground. My favourite place was a large patch centering in a big bottle tree, *Sterculia quadrifida* (?). Here was an open space, lightly timbered with small trees of *Melia azedarach*, the light green foliage of which formed a strong contrast to the sombre foliage of the dense scrub all around. Besides eucalyptus and bottle trees, the scrub was made up of such trees and shrubs as *Geijera muelleri* and *salicifolia*, which were covered with small yellowish flowers, *Leptospermum lanigerum*, *Bursaria spinosa*, *Nephelium* (sp.), *Hovea longipes*, *Solanum stelligerum*, &c. I am indebted to the Baron von Mueller for his kindness in giving me the names of plants, to Mr. C. French for names of Coleoptera, to Mr. A. H. S. Lucas for names of amphibia and lizards. From the open spaces alleys lead away into the recesses of the scrub, and along these numbers of the beautiful *Danais erippus*, *Papilio erectheus*, and *Acrasca* (sp.) kept flying to and fro. Of birds, probably because I was not specially on the look-out for them, I saw very few.

The two most numerous forms of life were ants and millipedes. The moment you put anything which could serve as food for them on the ground, the former appeared as if by magic. Several times they spoilt butterflies just while I put them down on the ground and made a paper bag for them. They always bit off first the little knob at the end of the antenna. White ants of course abounded, and in the tree trunks were swarms of native bees. There were not as many logs to turn over as could have been wished for, and the ground also was rather too dry and sandy.

We began by digging around the base of the big bottle tree, and, after digging some time, came across some large worms, about two feet in length. These differ in habit from any others I have collected. The burrow runs down for perhaps two feet, and then opens into a small chamber. The head end of the worm lies usually a short distance up the burrow, whilst the greater part of its length is twisted into a knotted coil, and lies in the chamber which may also contain one or two smaller, immature forms, evidently the young of the larger ones. Under and in rotten logs you often meet with a shortish, stout worm, perhaps six or eight inches in length, which, at first sight, differs very much from the long one. Its body is stiff, and the surface comparatively dry, whilst the other is four or five times its length, the body soft and the surface always very slimy. The short one I met with all along the Burnett River, at Gympie and in the palm district between this and Brisbane, whilst Mr. D. Le Souëf collected it at Toowoomba. It is the *Cryptodrilus purpureus* of Michaelsen, and, much though the two differ in habits and appearance, the long one is at most a variety of the short, typical form. I only got it in this one spot. In the scrub were some four new species of the same genus, and three new species of a genus (Didymogaster) of which previously only one species had been described from New South Wales, by Mr. Fletcher. Of the typical Victorian genus, Megascolides, to which our large Gippsland earthworm belongs, I did not find any example in Gayndah, but the Perichætes were fairly well represented.

Most of the earthworms were secured under fallen logs and in rotten trunks of the bottle tree. In times of drought the latter are cut down, and, containing a great amount of moisture, are eaten readily by cattle.

The season was too early for beetles, but amongst others I secured specimens in the family Carabidæ of *Carenum deauratum* and *bonelli*, *Eutoma* (sp.), *Philoscaphus mastersii*, and *Homaloscma hercules*; and, in the Paussidæ, of *Arthropterus* (sp.). One species of the genus *Leptops*, in the Curculionidæ, simply swarmed on the bark of the bottle trees and some of the upturned logs in the more open parts were alive with the little red form, *Lemodes coccinea*.

A short time before leaving for Queensland I had been struck with the presence of curious laterally-placed segmental openings in a very large millipede from Fiji, which Mr. French had kindly forwarded to me. In the Gayndah scrub—where smaller, but still large, millipedes abounded—I was interested to find the meaning of these openings. Each one is connected with a gland, and, when irritated, the animal passes out a few drops of a most obnoxious fluid, of a red-brown colour, the function of which must be protective. Whilst on this subject, I may mention that one morning, when Mr. Frank Connelly and myself were digging for worms, we accidentally cut in two a cockroach. From between the segments in its back it poured forth a milky white fluid, possessing an odour so execrable and pungent that it drove us from the spot.

Under logs we found, also, of land planarians, *Geoplana cærulea* and *variegata*, and amongst Vertebrata, the frogs *Limnodynastes tasmaniensis*, which was common everywhere, and *Hyperolia marmorata*. Of lizards, we secured species of Phyllodactylus, Pygopus, Grammatophora, Hinulia, Liolepisma, and Egernia. Snakes were rare, only the genera Morelia, Furina, and Hoplocephalus being represented. Whilst in the scrub I did not see a single marsupial.

On the road from Biggenden to Gayndah I had been struck with the appearance of two small hillocks capped with basalt. The country all round was thinly wooded with nothing but gum trees, but just the tops of these two hillocks were rich with vegetation, though each was at most fifty yards in width. Dr. Cole, Mr. Illidge, and myself drove out to see if there were anything worth collecting. Unfortunately, since I had passed along the country had been fired and everything was as dry and parched as it well could be. However, just the very cap of the hills still formed a strong contrast to the surrounding country, and here we found growing—though nowhere else, apparently, except in these two very limited areas—*Damara robusta*, the Queensland Kauri, *Cupania xylocarpa*, *Micromelum pubescens*, *Carissa brownii*, *Citriobatus* (sp.), and amongst ferns a rich growth of *Polypodium* (sp.), and *Adriantum* (sp.). Animal life was almost absent. We disturbed three wallabies, but except these and a few millipedes and scorpions and endless ants, there was nothing to be seen.

My time was passing by rapidly, and though I would much have liked a few more days in the Gayndah scrub, it was a choice between this and two or three days in the palm district between Gympie and Brisbane. Regretfully I left Gayndah, and taking the coach back to Biggenden, found myself in the evening in Maryborough. In the morning I had about two hours to wander about. Close to the town were camped some blacks. It was curious to note how they had adapted themselves to their environment. They had made their "humpies" out of old sheets of corrugated iron. A semi-clothed native lying down in the shelter of a mia-mia made of English corrugated iron formed as incongruous a mixture as could well be imagined. Early in

the afternoon I left the train at Cooran and took up my quarters in a delightful little wayside inn surrounded by ferns. On going up to the house I detected at once the genuine Lancashire dialect, and knew that the owner hailed from within ten miles of Manchester. I was accordingly made welcome, and wandered out to do a little collecting before evening came on. I found myself just on the northern border of the palm scrub which ran in a broad belt of about twenty miles width across the country from east to west, inland from the sea coast. The country was fairly hilly with a few isolated peaks standing out clearly. I was just at the base of one of these—Cooran—and to the south lay two more—Cooroora and Pimparan. South from these again the ridges increased in height, and then the country fell away into the slightly undulating plains which stretched eastwards towards Bribie Island and southwards to Brisbane. Some remarkable peaks, called the Glass Mountains, mark the southern end of the hilly district.

So far as animals are concerned, I was much disappointed with this palm scrub, but equally delighted with the richness of the vegetation.

Commencing first near to Cooran, I followed back the line and "log-rolled," finding a few worms and four land planarians (*Rhynchodemus obscurus*), a small, dark-coloured form, and *Geoplana cærulea* and *variegata*, together with specimens of a very small new white species, to which Dr. Dendy has given the name of *G. minor*. After long searching I came across *Peripatus leuckartii*, very dark purple in colour and evidently similar to the typical form and without the curious diamond-shaped markings characteristic of the Victorian form. Though searching hard, I only found nine specimens altogether, and all these close to Cooran. Most of my time was spent in this scrub at different parts, and usually in company with George Martin, the son of my Lancashire friends, who helped me very considerably in collecting. The scrub was very thick with vines and prickly lawyers and barristers and supplejack, making progress tedious, and there were comparatively few logs on the ground. What delighted me most were the ferns. The trunks of the pines and gums were often covered over with them and with orchids. High up were enormous clumps of the bird-nest fern (*Asplenium nidus*), and larger ones of the staghorn (*Acrostichum alcicorne*). Some of the latter measured fully twelve feet through, and from them hung down lovely pendant fronds of smaller ferns, especially of *Polypodium tenellum*, which is locally known as the feather fern. On the ground grew various species of Davallia, Adiantum, Pteris, Doodia, Aspidium, Polypodium, &c. Perhaps the most beautiful of all were the large and delicate fronds of *Adiantum formosum*. There were apparently three forms of palms—species of Ptychosperma, Livistona, and Kentia. The latter is very common, and usually known as the walking-stick palm. In the scrub were great pine trees, and under the bark stripped off from these, and lying about in large slabs, I expected to find any number of worms and insects, but was much disappointed. Millipedes and scorpions were there, and two large forms of land shells; but scarcely an insect to be seen, and not a planarian or peripatus. I got a few new species of earthworms, of which, again, the commonest form was *Cryptodrilus purpureus*; and in rotten logs, which, unfortunately, were few in number, were large forms of cockroaches. The earthworms formed the best part of my collection here, and comprised representatives of five genera—Perichæta, Megascolides (one species, the only one found), Cryptodrilus, Perissogaster, and Acanthodrilus. The latter is only recorded, as yet, from Northern Australia, where there are two species, and is characteristic of New Zealand. Perissogaster is peculiarly Australian and has only three species yet known. My specimens were obtained by digging on the banks of a creek at Cooran and were whitish in colour and about 1 to 1½ feet in length. The boys use them for fishing, quite unaware of their scientific value.

In Queensland, as in Victoria, I could very rarely, indeed, find traces of casts made by worms or of leaves dragged down into the burrows, and it would appear that here, as in Africa, the ants are of more use than the worms as agents in turning over the soil. Under the bark and logs were a few frogs—*Pseudophyrne bibronii* and *coriacea*, *Crinia signifera*, and a female specimen of *Cryptotis brevis*. In certain spots there were great numbers of trap-door spiders. Some of the tubes, which led for about 2·4 inches down into the ground, were an inch in diameter. The top of the tube, with its semi-circular trap-door, projects slightly above the surface.

One of the most striking features of the scrub were the epiphytic orchids, of which, owing to its size and large pendant masses of yellow-brown flowers, *Cymbidium canaliculatum* was the most noticeable. In parts the ground was crimson with the fallen berries of a species of Eugenia: we cut one down about sixty feet high, laden with fruit, which has a tart taste, and from its colour and size has caused the tree to be known as the native cherry. Another Eugenia has a large purple fruit, and is hence known as the native plum. High up, some fifty feet above ground, we saw hanging down clusters of light brown fruit. Luckily there was a hanging vine close at hand, and up this George Martin went like a monkey. The fruit belonged to the tree *Dysoxylon rufum*, and each was covered over with innumerable minute stiff hairs, which pierced the skin in hundreds. Other plants we noticed were the wistaria, which here grows wild, *Dracæna angustifolia*, and one which Baron von Mueller has marked as rare—*Rhipogonum elseyanum*. Two dangerous ones are common, one with large bright green leaves and succulent sheathing stalks, which is locally known as the "Congey Boy"—this is eaten greedily by the native turkeys, but has the effect of making a man's tongue swell to an enormous extent; the other is the stinging tree, *Urtica gigas*—the sting of this is extremely painful, and seems to prove fatal to horses, driving them rapidly frantic.

Close by the base of Mount Cooroora, a beautiful specimen of *Macrozamia denisoni* in fruit was growing, and on Mount Cooran the rock on the western side was completely overgrown with staghorn and bird-nest ferns and with an orchid, *Dendrobium* (sp.), with beautiful clusters of delicate white flowers, amongst which trailed *Kennedya rubicunda*, its bright red blossoms contrasting strongly with the pure white of the orchids.

My last day I spent at the Glass Mountains—curious cone-like basaltic structures rising abruptly from almost flat country. The day was oppressively hot, making it no small exertion to even turn over a log, and as the sun went down a heavy storm came up, and from the train I caught my last glimpses of this delightful district lit up by almost incessant flashes of brilliant lightning.

SCIENTIFIC SERIALS.

The American Journal of Science, July.—The change of heat conductivity on passing isothermally from solid to liquid, by C. Barus. The method employed was a modification of Weber's, who placed a thin, wide, plane-parallel plate or layer of the substance to be examined between and in close contact with two thick plates of copper. The system was first heated so as to be at a given temperature throughout. It was then suddenly and permanently cooled at the lower surface, and the time-rate at which heat travelled from the top plate to the bottom plate, through the intervening layer, was measured by a thermo-couple. From these data the absolute thermal conductivity of the layer may be computed, the constants of the system being known. In the experiments discussed, the liquid was thymol, which can be kept either solid or liquid between 0° and 50° C. This was heated above its melting point, and introduced through a central hole in the upper plate; it was then allowed to cool down until undercooled. The temperature was regulated by enclosing the whole apparatus in a sheet-iron jacket, through which water was kept circulating. The lower plate could be cooled by flushing it with water from below. The difference of temperature of the plates was measured by means of a copper german-silver couple. The liquid was solidified by introducing a crystal through the central hole. The results obtained gave for the absolute conductivity of thymol in g/cs:

Solid thymol at 12°, $k = 359 \times 10^{-6}$
Liquid thymol at 13°, $k = 313 \times 10^{-6}$

The thermometric conductivity was found to be—

For solid thymol at 12°, $= 1077 \times 10^{-6}$
For liquid thymol at 13°, $= 691 \times 10^{-6}$

—On polybasite and tennantite from the Mollie Gibson mine in Aspen, Colorado: by S. L. Penfield and Stanley H. Pearce. Large quantities of polybasite or "brittle silver" have been mined nearly free from gangue, assaying from 10,000 to 16,000 ounces of silver to the ton. Tennantite, arsenical tetrahedrite, or "grey copper," was found in smaller quantities, containing about fourteen ounces of silver. The rich ore occurs between a

hanging wall of black carbonaceous shale and a foot wall of grey magnesian limestone, which is probably of lower carboniferous age. The ore is richest and most abundant immediately under the black shales. Other minerals observed are native silver, argentite, galena, sphalerite, siderite, barite, and calcite.—Post-Laramie deposits of Colorado, by Whitman Cross. This paper, published by permission of the director of the United States Geological Survey, deals with some beds occurring between the lowest eocene and the marine cretaceous deposits, which have hitherto been classed with the Laramie formation of the Rocky Mountains. The age of the firm grey sandstones and coal-measures of the latter has long been doubtful, and they have been variously described as secondary and tertiary. In the Denver region, two beds are found overlying the Laramie unconformably, the one consisting of a pebbly conglomerate, the other of débris of andesitic lavas; they have been termed the Denver and Arapahoe formations respectively. Their equivalents have been found in various other parts of Colorado. When, after the continental elevation which caused the retreat of the Laramie seas, sedimentation began again, it was in comparatively small seas or lakes. Succeeding the first period of lake-beds came a time of great volcanic outbursts over a large area. The length of geologic time occupied may not have been very great, but the extent of country in which eruptions occurred at this time, and the great variety of lavas found in the Denver and Middle Park regions, argue for the decided importance of the event as a dynamic manifestation. The writer wishes to advocate the restriction of the term Laramie, in accordance with its original definition, to the series of conformable beds succeeding the marine Montana cretaceous, and the grouping of the post-Laramie lake beds in another series, to which a comprehensive name shall eventually be given.—On the alkali-metal pentahalides, by H. L. Wells and H. L. Wheeler. With their crystallography, by S. L. Penfield. An account of the preparation and properties of compounds of the formulæ CsI_5, $CsBr_5$, $CsCl.Cl_3I$, $RbCl.Cl_3I$, $KCl.Cl_3I$, $NaCl.Cl_3I.2H_2O$, $LiCl.Cl_3I.4H_2O$. The first is triclinic, the third, fourth, and fifth are monoclinic, and the Na salt is orthorhombic.—Fossils in the "archæan" rocks of Central Piedmont, Virginia, by N. H. Darton. Remains of crinoids belonging to the upper Ordovician fauna were found in the roofing slate of Arvon, Buckingham County, Virginia, which has hitherto been classified as Huronian.—Notes on the Cambrian rocks of Virginia and the southern Appalachians, by Chas. D. Walcott. It is shown that towards the close of middle Cambrian time, and during upper Cambrian time, there was a decided continental movement, resulting in the depression of the interior continental plateau, and that this was accompanied by the formation of conglomerates of the older Cambrian rocks in the valley of the St. Lawrence, and by a great deposition of sediments of later Cambrian time in the southern Appalachian region.—Synthesis of the minerals crocoite and phœnicochroite, by C. Ludeking, Ph.D. This was accomplished by exposing for several months to the air a solution of lead chromate in caustic potash in a flat dish. A mixture of the two kinds of crystals resulted, which could be easily sorted by means of a pincette.—A hint with respect to the origin of terraces in glaciated regions, by Ralph S. Tarr. Tracing a resemblance between the flood terraces of the Colorado in Texas, and the glacial terraces of the Connecticut.—Occurrence of a quartz boulder in the Sharon coal of north-eastern Ohio, by E. Orton.—A method of increasing the range of the capillary electrometer, by John Whitmore. An account of some experiments performed in the Sloane Physical Laboratory of Yale College, with a view towards improving the mercury and sulphuric acid electrometer as constructed by Lippmann and Pratt. Instead of having alternate bubbles of the two liquids, the surface of the mercury exposed to oxygen polarization was increased by blowing the tube into bulbs at the junction. A series of bulbs was blown, spaced at equal intervals along a capillary tube, the diameter of the bulbs being two centimetres, that of the tube 0·6 mm.; then the tube was so bent that the whole contained as many U-shaped parts as there were cells. One arm of each U was provided with a bulb, which was situated at a distance of two-thirds the height of the U from the base. The apparatus was filled by connecting it with an aspirator, and drawing in sufficient mercury to half fill each bulb, after which dilute sulphuric acid was added by the same means. Platinum electrodes were used, and the variations in the height of the mercury columns produced by the E.M.F. examined, were read by means of a cathetometer. The deflection produced by a standard Clark cell was 3·20 mm. The range of the instrument is limited by the E.M.F. required to produce continuous electrolysis, but it was found that it could be considerably increased by using a larger number of cells in series. It is possible to determine with this electrometer the E.M.F. of a cell correctly to 0·001 of a volt.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, June 16.—Prof. A. Crum Brown, F.R.S., President, in the chair.—The following papers were read:—Contributions to an international system of nomenclature. The nomenclature of cycloids, by H. E. Armstrong. An account was given of the proceedings at the recent Conference on Chemical Nomenclature at Geneva, and attention was directed to the significance of the chief resolutions. A report of the conclusions arrived at by the Conference has already appeared in NATURE (this vol., p. 56).—The production of pyridine derivatives from the lactone of triacetic acid, by N. Collie and W. S. Myers. The product of the interaction of ammonia and triacetic lactone is most probably an $\alpha\gamma$-dihydroxy-α-picoline. By the action of phosphorus oxychloride on this substance a compound possessing all the properties of a dichloropicoline is obtained, and on passing this, together with hydrogen, over heated zinc-dust, α-picoline boiling at 128–129° is produced. The melting points of the platini- and auri-chlorides, obtained from the synthetical alkaloid, agree with those given by the corresponding compounds prepared from pure α-picoline which was made by heating pyridine methiodide.—The fermentation of arabinose by *Bacillus ethaceticus*, by P. F. Frankland and J. MacGregor. The products are qualitatively the same as were obtained in the fermentations of glycerol by the same organism, consisting of ethyl alcohol, acetic acid, carbon dioxide, hydrogen, and traces of succinic acid, together with another acid which was not identified. When the fermentation is conducted in a closed space a notable proportion of formic acid also occurs among the products. In this case the products are formed approximately in the proportions—$3C_2H_6O$, $3C_2H_4O_2$, $4CH_2O_2$, the formic acid as well as the carbon dioxide and hydrogen found being all collected together as formic acid in this statement. In the fermentations conducted in flasks plugged only with cotton wool, on the other hand, the alcohol and acetic acid were formed in the proportion $2C_2H_6O$, $3C_2H_4O_2$. It appears, therefore, that in the fermentation of arabinose by *Bacillus ethaceticus*, the proportion of acetic acid to alcohol is greater than in that of dextrose, and still greater than in the cases of mannitol and glycerol, but less than in that of glyceric acid.—Resolution of lactic acid into its optically active components, by T. Purdie and J. W. Walker. The authors have resolves ordinary inactive lactic acid into lævo- and dextro-lactic acid by taking advantage of the different solubilities of the strychnine salts of these components. Strychnine lævolactate is considerably less soluble in water than the dextrolactate, although both salts may be crystallised. By fractional crystallization of the mixed salts and subsequent removal of the strychnine from the crystals and mother liquor, by means of ammonia or barium hydrate, solutions were obtained which were respectively dextro- and lævo-gyrate. The dextrolactate yielded a zinc dextrolactate having the same composition and solubility as zinc sarcolactate. A well-defined dextro zinc ammonium salt of the composition $Zn.NH_4(C_3H_5O_3)_3$, $2H_2O$ having the specific rotatory power $[\alpha]_D = +6·49$ (approx.) was prepared. The dextrogyrate salts yield a lævogyrate acid, which, like sarcolactic acid, gives an oppositely active anhydride. The quantities of oppositely active acids separated from each other by means of the strychnine salts possessed equal amounts of optical activity. Fermentation lactic acid is thus shown by analysis to consist of two oppositely active isomeric acids, one of which is identical with dextrogyrate sarcolactic acid, and the other with the lævogyrate acid prepared by Schardinger by the bacterial decomposition of cane sugar.—A new method for determining the number of NH_2 groups in certain organic bases, by R. Meldola and E. M. Hawkins. In order to ascertain the number of NH_2 groups present in certain organic bases the authors propose to form the azoimides; on analysis of these substances, the number of amidogen groups which have been diazotized, can be determined. For example, paradiamidoazobenzene $(NH_2.C_6H_4)_2N_2$ was diazotized and converted into

tetrazoperbromide in the usual way. This latter substance, by the action of ammonia, yields lustrous silvery scales of the azoimide.

The analysis of this substance proves without doubt that two amidogen groups were present in the original base.—The existence of two acetaldoximes. Second notice, by W. R. Dunstan and T. S. Dymond. The authors have more fully investigated the change undergone by acetaldoxime on heating (see NATURE, this vol., p. 94). The pure crystals melt at 46·5°; after heating at 100° for a few minutes the liquid does not begin to crystallize until 13°. On separating the crystals now formed, and cooling the liquid still more a further crop of crystals is obtained. Each of these separations is found to melt at 46·5°. Acetaldoxime therefore exists in two modifications, one, the crystalline form melting at 46·5°, and the other, a liquid form which the authors find cannot be obtained in a pure state, as when it approaches purity it partially reverts to the modification melting at 46·5°.—The dissociation constants of organic acids, by J. Walker. The author has measured the dissociation constants of a number of organic acids and ethereal salts.—Note on the preparation of alkyl iodides, by J. Walker. The author has devised a method for conveniently and rapidly preparing considerable quantities of methyl and ethyl iodides. The apparatus employed consists of a modified fat extraction apparatus, by means of which the iodine is dissolved by the condensed alcohol, and runs into a vessel containing the phosphorus and alcohol. The method gives a good yield, and may be applied to the preparation of higher iodides.—An examination of the products obtained by the dry distillation of bran with lime. Preliminary communication, by W. F. Laycock and F. Klingemann. On distilling a mixture of bran and quick-lime, a black oil, floating on an aqueous solution is obtained. The aqueous solution smells of herring brine, contains much ammonia, and on boiling evolves inflammable gases. The oil is evidently a complex mixture, and has not yet been separated into its constituents.—The atomic weight of palladium, by G. H. Bailey and T. Lamb.—The action of sulphuryl chloride on acetorthotoluidide and acetparatoluidide, by W. P. Wynne.

PARIS.

Academy of Sciences, July 18.—M. d'Abbadie in the chair.—On a slight additive correction which may have to be applied to the heights of water indicated by sea-gauges, when the swelling or chopping agitation of the sea reaches a great intensity: case of a choppy sea, by M. J. Boussinesq. In this second case the correction is much smaller than in the former, amounting to not more than 0·1 mm. in an extreme case.—Preparation and properties of proto-iodide of carbon, by M. Henri Moissan. If an exhausted sealed tube containing crystals of the tetra-iodide of carbon be heated in an oil bath to 120°, iodine is liberated and condenses in the cooler portion of the tube, while less volatile crystals of the proto-iodide of carbon are produced, corresponding to the formula C_2I_4. To obtain greater quantities, the tetra-iodide is reduced by silver powder. The substance obtained presents itself in beautiful pale yellow crystals of density 4·38, fusing at 185°, and volatile without decomposition below their point of fusion. By slow volatilization in a vacuum at a temperature between 100° and 120°, transparent crystals are produced, some of which form highly refracting hexagonal tablets. The proto-iodide is very soluble in carbon bisulphide, tetrachloride, and ordinary ether, which, by cooling, gives good crystals. The new compound is very stable, being not oxidized by potassium permanganate, and boiling chromic and nitric acids.—On one of the reactions of spermine, by M. Duclaux.—On a fossil baboon of the quaternary phosphorites of Algeria, *Macacus trarensis*, by M. A. Pomel.—Project of meteorological observatories on the Atlantic Ocean by Albert I., Prince of Monaco. A proposal to establish a station on the Azores as soon as the projected cable is laid, and also on Madeira, the Canaries, Bermuda, and the Peak of Teneriffe. It is expected that the prediction of cyclones will be much facilitated, and Monaco is suggested as a centre for the collection and distribution of the information obtained.—On the specific heat and the latent heat of fusion of aluminium, by M. J. Pionchon. The total quantity of heat required to raise 1 gr. of aluminium from 0° to its fusing point, 625°, is 239·4. The latent heat of fusion is very large, being equal to that of water, viz., 80 cal.—On the measurement of the dielectric constant, by M. A. Perot. The further value obtained for glass was 2·39, which, obtained by means of a glass prism weighing 65 kg., agrees very well with that obtained from very rapid oscillations. The values obtained by these two methods, being unaffected by residual charges, are more reliable than those derived from the static, the attraction, and the ballistic galvanometer methods.—On the principle of maximum work, by M. H. Le Chatelier. An examination of the bearing of certain thermodynamic laws on Berthelot's principle, showing that the contradiction between them is only apparent.—On a basic nitrate of calcium, by M. A. Werner.—On the efflorescence of sulphate of copper and some other metallic sulphates, by MM. H. Baubigny and E. Pechard.—On the decomposition of the basic nitrates by water, by MM. G. Rousseau and G. Tite.—On phosphopalladic combinations, by M. E. Fink.—On the mechanical contrast between the radical cyanogen and the chloroid elements, by M. G. Hinrichs.—The influence of the substitution of the methyl group for one benzene hydrogen on the properties of orthotoluidine, by M. A. Rosenstiehl.—On the instability of the carboxyl in the phenol acids, by M. P. Cazeneuve.—On preserved ferruginous mineral waters, by M. J. Riban.—On a new leucomaine, by M. A. B. Griffiths.—Effects of sudden release on animals placed in compressed air, by M. G. Philippon. It was found that although rabbits subjected to a pressure of six or eight atmospheres were unaffected if the pressure was gradually released, a sudden expansion was followed by almost instantaneous death. The cause of death appears to be the mechanical expansion of the gas contained in the vessels, which, in the case of gradual release, is eliminated by the lungs in a few minutes.—On the immediate reparation of losses of intra-osseous substances, with the aid of aseptic bodies, by MM. S. Duplay and M. Cazin.—The coxal gland of the scorpion and its morphological relations to the excretory glands of the Crustacea, by M. Paul Marchal.—The avalanche of the Têtes-Rousses. Catastrophe of St. Gervais-les-Bains (Haute-Savoie), by M. F. A. Forel.—On certain forms of filling-up observed in some lakes of the Pyrenees, by M. Emile Belloc.

CONTENTS.